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GEOLOGICAL SURVEY HYDROGRAPHIC WORK.

We noted with deep regret the narrow-minded and petty policy put in evidence at Washington by the attack, unfortunately successful, on the last appropriation for the hydrographic work of the Geological Survey. It has been the time-honored policy of the pothouse politicians who sniff around the "pork barrel" at each successive session, to keep in so far as they are able the scientific department of the Government upon starvation rations. What has mere useful knowledge of the country's resources, or the advancement of the individual arts got to do with the patronage of the Steenth Congressional District, anyhow? There are no jobs for heelers made available and there are no grateful and generous "interests" to be served, so the appropriations are cut down and the work comes to a halt. The whole history of the scientific branches of the Government service is a tale of niggardly dealing whenever the attention of the wiser statesmanship has been temporarily diverted. Eternal vigilance is the price of existence for those who cannot afford to support a lobby. At the time of the last appropriations an assault by the pork-loving patriots succeeded in cutting down the provision for hydrographic work from $200,000 to $150,000. The larger figure, which had been granted for the four previous years, was all too small for the proper pursuance of the work of systematic gaugings, and the reduction necessarily crippled the work of the section. At the present session another appropriation is due and the friends of organized effort in developing American resources should come to the front and see to it that this important branch of public work shall be adequately endowed.

An accurate knowledge of the hydraulic resources of the country is of vast importance to many industries, and it can be attained only by the systematic and continuous study that can be given by a body like the Geological Survey. The value of a water power depends on conditions of flow which cannot be determined by casual inspection or by anything less than long-continued measurements. The prosperity of manufacturing enterprises often depends upon a cheap and adequate supply of power, and uncertainty in this particular is often costly. The great irrigation schemes of the West turn upon the certainty and availability of the water supply, and their successful outcome is sometimes closely involved with the concurrent question of power supply from the same sources. The study of these natural resources of the country is peculiarly a matter for Governmental action, since interstate, and indeed, international, questions are often involved, and because desultory efforts made by individuals and corporations at a few points are relatively valueless. Records of flow are valuable about in proportion to their completeness in time and localities. The variations most important in making a permanent investment in hydraulic works are not those from month to month, but those from decade to decade. A power may be sufficiently reliable through the year and yet be subject to fatal deficits in occasional dry seasons. One could make a rather considerable list even now of power plants which have been subjected to serious loss by dependence merely upon current data concerning the flow. As time goes on and water powers become more and more valuable, the need of exact knowledge

of the relations between rainfall and flow in various sections of the country will become progressively more important, and the years of regret will be bitterly regretted.

The need is for a complete exploration and study of the great source of wealth that lies in the flowing streams—a wealth alike available to manufacture and to agriculture. Great as is the capital invested in hydraulic power plants and irrigating systems, it is but a small fraction of that which will ultimately be required for such works. The most surprising feature of modern power transmission is the extraordinary way in which hydraulic possibilities have come to light in unexpected places. The half has not been told of the wealth that is thus hidden in streams. It is as proper a function of the Geological Survey to investigate this subject as it is to study the mineral wealth locked up in the mountains and the coal measures. The thing needed is a thorough and systematic exploration of the streams of the country for sources of power, coupled with a general permanent system of gaugings, kept up in pursuance of a regular plan, so as to give data for accurate judgment of the permanence and variations of flow. It is a large task, but one which by skillful management can be carried out at the cost of a very small percentage of the benefits derived. It would be very unreasonable to expect it to pay for itself month by month, since continuity is the very essence of its value. Yet the finding of a single power may add many times the annual cost of the whole service to the wealth of the country, and the checking of a single hydraulic blunder may save as much more. However, short-sighted individual effort may be, it is certainly the duty of the Government to build for the future—to look far beyond the small interests of the hour—to plan for the nation that does not die with the generation now alive. It is perhaps one of the inherent faults of a republican form of government that it is too closely confined to temporary policies and tends to small if not to large instabilities. Yet it is capable of consistent evolution, as some of the larger policies of the founders of the republic bear witness. It rests with the statesmen of wider vision to suppress the selfish machinations of those who will not look beyond their private interests, and to teach them that in the long run honesty is the best policy, and that the path to oblivion lies through negligence of duty to the people at large.

Isolated Plants for the Country.

The article in this issue by Mr. Putnam A. Bates brings out very forcibly the opportunities and advantages that a private plant offers to people living in suburban and country districts. What he says about the present internal combustion engine and the storage battery is entirely true, and their use for just such purposes as he cites is rapidly increasing. From the point of view of economy and usefulness on the farm, there are few establishments where the isolated electric plant would not prove an economy. Churning, wood cutting, threshing, cutting and grinding of hay, corn and grain for fodder for the stock and poultry, can be done by electric power. The difficulty of obtaining farm hands and of providing for them makes the machine which can be satisfactorily substituted for manual labor, a great advantage. The practical farmer appreciates the good things of life as well as any one else, but he sometimes needs to have the means by which he may obtain them pointed out to him, for his very nature and his mode of living bring him very little in touch with the industrial world, with the result that he does not always realize the opportunities which lie quite within his grasp.

The suggestion, therefore, that he may utilize his picturesque stream and ice pond for a water power with which to generate electricity for both power and lighting, and that he can install the machinery to do this, at a very moderate cost, should prove an eye-opener to many agriculturists. The country estate is no longer complete unless supplied with electric current, whether from a public service connection or from a private plant. The preference of course should be given to the one which figures out as the more profitable, all things considered. Mr. Bates divides into three distinct classes the conditions which make an electric plant desirable, and from his analysis it is apparent that the conditions which often obtain even at comparatively small country residences would justify the installation of an isolated plant. We hope to see a good deal of this work done in the coming year.

Determination of Electrostatic Capacity by Electrolytic Means.

Although the major portion of those who deal with electricity in its various phases received their first conception of the mysterious "substance" in its state of rest as static electricity, and were subsequently instructed concerning electricity in motion as current, yet the fact remains that many electrical workers who are well versed in the laws relating to electricity in motion have hazy ideas with reference to electricity at rest. The explanation of the conditions outlined in the above statement may be found in the fact that in most practical operations the static effects are relatively small in comparison with the so-called dynamic effects, and sufficiently accurate results are obtained by ignoring the presence of the former. It is well known that every charged conductor, or conductor through which charges are being conveyed—that is, every conductor carrying current—influences by "static" induction every other conductor in the neighborhood; but, except in the case of circuits carrying currents alternating at high frequency, the static effects are seldom prominently manifest, and rarely is any attempt made to determine their magnitude. The conditions usually existing in practical installations are such that specially constructed and delicate instruments must be used for ascertaining the magnitude of the static influence of one conductor upon another, except in the case of the condenser, which is arranged so as to embody the maximum of static induction, and long-distance transmission circuits, which are in themselves a special form of condenser. To the difficulty in measuring the value of the static effects may be attributed the lack of diffusion of information concerning the electrostatic phenomena in ordinary electrical equipments.

An extremely interesting method of determining the electrostatic capacity by the use of resistance measuring instruments is described in an article by Dr. A. E. Kennelly and Mr. S. E. Whiting, on page 1230 of this issue. The authors show from mathematical considerations that the laws relating to the electrostatic capacity of a condenser are similar to those connected with the electric conductance beween two terminal surfaces of any uniform medium which might be substituted for the dielectric of the condenser. By applying the information gained from the above-mentioned considerations, it is possible to employ a geometrical model of the condenser and measure its conductance and thereby ascertain the capacity of a condenser whose shape and dimensions are such that the mathematical computation or the physical measurement of the actual capacity would be very difficult. Using for the uniform conducting medium a copper sulphate solution, the authors made careful observations of the

conductance of models corresponding to the condenser formed by the ground and the vertical antenna in wireless telegraphy. The fact that observations made upon separate models when reduced to common dimensions are consistent among themselves, combined with the substantial agreement of the experimental results with calculations made with certain approximate formulas, indicate that the method possesses considerable practical value when used with discretion. It is necessary to eliminate the errors introduced by the e.m.f. of polarization, and in interpreting the results it is essential to know the relation existing between the specific conductivity of the electrolyte of the model and the specific dielectric capacity of the actual condenser. Moreover, the electrolyte models used by the authors afford excellent analogues for giving physical interpretations to mathematical expressions for representing the electrostatic capacity of condensers having irregular dimensions or unusual proportions.

LIGHT AND ILLUMINATION.

The paper on this subject by Dr. C. P. Steinmetz, read before the Illuminating Engineering Society, and abstracted in our issue of last week, contains much interesting material of both a physiological and physical character. The keynote of the paper lies in the contrast between mechanical engineering and illuminating engineering. In mechanical engineering the underlying principles relate to statics, dynamics and mechanics, or the laws of the universe external to man. In illuminating engineering, however, the underlying principles are both physical and physiological. They include laws of the action and behavior of the human eye. The commodity whose business it is for illuminating engineering to administer and control is not merely radiant energy, but the physiological sensation and stimulus of light as perceived by the eye in the presence of certain types of radiant energy. Consequently, a student of the science relating to illuminating engineering must include physiology and opthalmology, to some extent at least, in his studies. Physiology is obviously a science of enormous importance to humanity. It is, however, not yet an exact science. That is, the laws of physiology are seldom known to be correlated mathematically, or to be related mathematically to physical and chemical laws. There can be no doubt that such mathematical relations exist; but the subject of physiology is so intricate and recondite that there has not yet been time to unravel its numerical relations. All the exact sciences have had to pass through an initial stage of inexactness. Chemistry was once blissfully devoid of arithmetical relations, and the same was originally true for physics and mechanics. The more difficult the science, the longer the duration of the inexact stage of development. Although arithmetic is beginning to establish lines of advance in physiology; yet it is interesting to observe how, in regard to the action and properties of but a single organ—the human eye—the science of optics brings theoretical quantitative relations into consideration; while the art of illuminating and technics of illuminating engineering, bring practical quantitative relations into consideration. From both of these quantitative bases the arithmetic of the physiology of the eye is capable of being advanced.

An interesting point made in the paper, and sustained in the discussion, is that uniform adequate illumination unaccompanied by shadows, is neither useful nor pleasing, neither grateful nor comforting. If all the objects in a room happened to have precisely the same color, and if the illumination were perfectly diffused, so that there were no shadows, the objects could not be distinguished by the eye. The eye requires either a distinction in the color of an object, or a distinction in light and shadow, in order to perceive the outlines of the object and detach it from its background. Shadows aid the eye materially in recognizing and distinguishing objects one from another. Shadow has as normal and proper a function in the sensation of light as has discord in sound sensation, hunger in feeding, or pain in feeling. It is only excessive shadows which are unsuitable and undesirable. A single naked arc lamp in a room with poorly reflecting walls and ceiling gives an illumination that is very unpleasant, owing to the sharp contrasts of bright light and deep shadow. On the other hand, however, a room lighted solely by reflection from walls and ceiling, with concealed lamps, and nearly perfect diffusion of light, may allow of easy newspaper reading everywhere, yet is likely to give a feeling of uneasiness from an absence of shadows. Human eyes have been accustomed for so many thousand years, in successive generations, to sunlight and moonlight, with their accompanying shadows, that a shadowless environment is not pleasing to mortals.

Allusion was made to the phenomenon, first recorded by Purkinje, that the perceptibility of different colored illuminations varies with the intensity of that illumination. When a red and a green lamp are placed side by side, and adjusted by the observer in their immediate neighborhood, to what seems equal strengths, or equal luminous intensities, when the observer walks off to a considerable distance, the green light looks the brighter, and he can read print farther off with the green light alone than with the red light alone. Expressing the result in another way, when illumination is very feeble, the eye is most sensitive to green light. This might be a residual trait handed down from our far remote ancestors when they were fishes, since the color which is least absorbed by salt water, or the color which is farthest transmitted in feeble intensity, is green. Some light is incidentally thrown by the paper upon the disputed question as to whether the bluish mercury arc light is severe on the eyes of draughtsmen, or not. Some say that draughting rooms illumined by mercury arc lamps are easy to work in, while others maintain that such rooms overtask the eye. It seems, from what is stated in Dr. Steinmetz's paper, that the iris or protective diaphragm of the eye, readily responds to green light and particularly to light of yet longer wave length, such as red; but it does not respond so readily to shorter wave light, such as blue. The eye cannot, therefore, easily protect itself from an unduly strong blue light, although it can easily protect itself from green, yellow or red light. If, therefore, drawings are illuminated by the bluish light of the mercury arc, the effect will be good, and not severe, provided that the intensity of illumination be moderate. If, however, the intensity be too high, the eye may be fatigued because of being unable to protect itself by closing down the iris diaphragm. Here again the habit of the eye towards sunlight is apparent. The sun does not give us a copper-sulphate blue illumination. This is reserved for scenic effects in melodrama. The sun gives from white, which holds a small percentage of blue in solution, at noonday, down through yellows and greens to red at dawn or sunset. The eye has learned to stop down through its iris diaphragm the illumination on the retina in these working colors, and has not had to learn such adjustment for unmixed blue light. How many generations of living indoors exclusively by the artificial light of the mercury arc type would be needed to acquire the full automatic protection of the iris to this light, it is unnecessary to speculate upon.

Royal Society Medals.

The scientific world is always interested in the medal awards of the Royal Society because of the eminence of the men who receive them and also because of the éclat of the accompanying ceremonies. The awards were made this year, as customary, at the anniversary meeting, which, from time immemorial, was held on St. Andrew's Day. The unusually brief address of the president, Lord Rayleigh, touched upon the work done in the multifarious branches of science, and contains, as one would expect from such an authority, characteristic remarks upon contemporary work in mathematical and physical science. After a brief comment upon a solution of a famous problem in the very difficult branch of diffraction, given by Sommerfeld, he encouragingly remarks that "we are not to despair of the eventual solution of difficulties that may be too much for ourselves." To this he adds a consideration that will appear quite obvious to most of our readers, viz.: that the physicist is greatly indebted to the theorist and mathematician; but while we make this concession very willingly, we likewise know that the great advances have been made when the investigator was at the same time a theorist and mathematician. As an illustration one example will suffice, irrespective of Lord Rayleigh himself—Hertz, who was able to wield the heaviest mathematical panoply without inconvenience and at the same time was capable of the infinite patience and resourcefulness which are known to be distinctive characteristics of the physicist.

Of the Royal Society honors, those that interest us most directly are the Rumford medal, awarded to Prof. Callendar, for his experimental work on heat. It is well known that the specific heat of water is not absolutely constant, as was assumed for a long time, but is a variable quantity that has given rise to a considerable amount of theoretical and practical trouble. Prof. Rowland was confronted with these grave difficulties in his classic determination of the mechanical equivalent of heat; he stated them very clearly in his paper, but left to others the bother of estimating them quantitatively. The bequest was not by any means an enjoyable legacy, but rather an inheritance bristling with experimental difficulties. It was taken up by Prof. Callendar and made a subject of careful measurement for many years past with the result that we now know the variation of the specific heat of water between the useful limits of 0° and 100° C. with a high degree of precision.

It is pleasing to see the recognition of Prof. Alfred George Greenhill's work in the domain of pure mathematics on such a memorable occasion as this. Prof. Greenhill is well known to mathematical readers in both hemispheres for suggestive papers on pure and applied mathematics published during the past thirty years. They embrace a great variety of mechanical and physical subjects, and also a treatise on hydromechanics which is remarkable for the originality of its views and treatment. Prof. Greenhill received one of the Royal medals, the other being accorded to Dr. Dukinfield Henry Scott for investigations in connection with fossil plants.

Of the seven medals awarded, it is not too much to say that the one which will prove of greatest interest to scientific readers is the Hughes medal, the recipient of which was Mrs. William E. Ayrton. It is a very unusual thing to give a Royal Society medal to a lady—indeed this is the first time it has ever been done—but the work accomplished by Mrs. Ayrton on the physics of the electric arc has shown not only ability of the first order for physical investigation, but has also served to clear up tangled and difficult matters in connection with the flow of current in the arc and has harvested at the same time a great number of important results on the accompanying luminous, acoustical and thermal phenomena.

While Mrs. Ayrton is honored by the Royal Society of London, it may not be out of place to say that another lady—Madame Curie—contemporaneously receives the highest honors of the University of Paris. For her paper on the discovery of radium, she received the degree of Doctor of Science, the highest distinction in the academical world; and on the tragic death of her husband was appointed to succeed him in the Professorship of Chemistry in the old, and rightly conservative, Sorbonne, an institution founded in the thirteenth century by Robert de Sorbon. It is not often that university students and post-graduates are called upon to listen to a lady professor expounding the newest discoveries in science as in the case of Madame Curie; other instances, however, will occur to the thoughtful reader. Perhaps one of the most interesting and pathetic is that of the beautiful and celebrated Maria Agnesi of Milan, who replaced her father in his lectures at the University of Bologna in mathematics, when he was unable to meet his classes by reason of illness. It is to the mathematical proficiency of this lady that students of analytics owe the curve known as the "witch" of Agnesi.

The Copley medal of the Society was awarded to Prof. Metchnikoff for his services on pathology and zoology; the Davy medal to Prof. Rudolf Fittig, of Strassburg, for his work in organic chemistry; and the Darwin medal to Prof. Hugo de Vries for his important discoveries in connection with the manner in which new races of organism may originate.

It is interesting to remember that the Rumford medal was founded at the beginning of the nineteenth century by our own countryman, Benjamin Thompson, of Rumford, now Concord, Mass., who, after his extraordinary work in Bavaria, took up his residence in London, and there founded the Royal Institution. Contrast with this act of the ex-patriated American the endowment by James Smithson, an Englishman, of the Washington Institution, which bears his name, and which has done so much for the advancement of learning in the United States.

The Copley medal was founded in 1704 by Godfrey Copley, F.R.S., for improving and extending natural knowledge. Like the Rumford distinction, it was thrown open to the whole world, though limited to the physico-chemical sciences.

In reviewing these awards of the Royal Society, we must confess to a lurking apprehension that everything is not quite right with the views put forth by some of this year's laureates on the divisibility of the atom and the astounding orbital capabilities attributed to the ultimate particle—the corpuscle of Prof. J. J. Thomson. Such theories may commend themselves to certain members of the advanced school of contemporary physics, but it would be easy for a phlegmatic and cool-blooded critic to point out difficulties, gratuitous assumptions and improved points that would make the calm, deliberate thinker say *festina lente*, if you please, in all these presumed advances in the philosophy of matter. The slower we go along these paths of uncertainty and obscurity, the surer will be the progress admitted and put to the credit side of our account by posterity; and the nearer, too, will we reach to a clear conception of that long-guarded mystery, the nature of the ultimate particle of matter.

The Effects of Municipal Ownership.

Mr. A. H. Grant lectured last week before the Unity Club, of Montclair, N. J., on the failure of socialistic methods in city government. In the course of this address he said:

"In spite of the denial of thoroughgoing Socialists, the ownership and operation by cities of traction, telephone, gas, electric light and water works is socialistic, in that it substitutes collectivism for private enterprise. The success or failure of such socialistic methods must be determined by a comparison as to cost and results with similar service performed by private enterprise. Such a comparison shows almost, if not quite, without exception that for equally good service the cost is increased by municipal ownership. As a matter of fact, the service is usually inferior, in spite of this increased cost.

"Inferiority of service," he said, "is due chiefly to the selecting of municipal employes for political reasons instead of for their fitness for the work required, the short tenure of office of the higher officials and their ignorance of the details of the work which they are expected to supervise and direct and the lack of the incentive of personal gain from the commercial success of the undertaking.

"As the political future of these higher officials depends upon keeping prices down they do not scruple to attain this result by allowing the works to deteriorate without making adequate allowance for depreciation. They fail to adopt improved machinery and appliances, while by skilful bookkeeping they throw upon the tax list much of the cost of renewals under the guise of

extensions, together with the charges for interest on bonds, for legal and accounting services, for damages and street repairs; in fact, everything that can possibly be shifted to other accounts.

"This has resulted in a material increase in taxation and consequently in rents and other prices, thus forcing the citizen who does not use electricity, for example, to pay part of the cost of supplying those who do. On the other hand, opportunities for graft are multiplied and it becomes easily possible for the unscrupulous officeholder to intrench himself in power by making unwarrantable concessions to the department employes. In this way boss rule is perpetuated and democratic government is supplanted by a bureaucracy which, because of the large number of employes, is well-nigh impregnable.

"The increased taxes and rents resulting from this municipal ownership put at a commercial disadvantage the manufacturers in cities where this form of socialism is prevalent, and make necessary either a removal to some other locality or the reduction of wages of their employes to compensate for the increase in their cost items, so that while city employes may receive higher wages than they could under private ownership, in the long run the money to pay this increase comes out of the pockets of the wage earners who are not thus favored. It is this last consideration which perhaps more than any other caused the recent revolt against municipal ownership in London."

Lecture on Rotary-Converter Sub-stations at Chicago.

Mr. R. F. Schuchardt, engineer of electrical construction of the Chicago Edison Company, gave an illustrated lecture before the electrical section of the Western Society of Engineers December 21, 1906. This lecture went into the theory and underlying principles of the instruments and apparatus used in connection with a system of rotary-converter sub-stations and therefore does not permit of satisfactory abstract. A curve was given showing an enormous increase in rotary-converter capacity connected to the Chicago Edison system since 1900, of which about 25 per cent annually was due to increase of lighting and power business. The abnormal increase was due to a taking on of considerable railway load for various street and elevated railway companies. The company had three miles of high-tension underground cable supplying sub-stations in 1897 and will have 240 miles at the beginning of 1907. Pictures of a number of sub-stations located in the basements of downtown office buildings were shown, it having been the policy of the company to locate such basement sub-stations at frequent intervals in the downtown district. One interesting development is the Plymouth Place sub-station, which, besides supplying a direct-current lighting network, also has railway converters in it for supplying the Chicago City Railway downtown lines. The speaker announced an advance soon to be made in the construction of rotary-converters of large size, namely, the use of a vertical shaft machine, thus making a lighter, more compact and accessible unit. In the discussion which followed Mr. P. Junkersfeld, electrical engineer of the company, being asked what progress had been made with vertical shaft machines in this country, said that the designs were not yet entirely completed. It was hoped to obtain in the vertical shaft machine something which would be much more accessible than the horizontal shaft rotary-converter of large size. The new machine would be of the "umbrella" type. It would be about 20 per cent lighter than horizontal shaft machines of the same capacity.

Mr. E. F. Smith, superintendent of sub-stations of the Chicago Edison Company, presented a very interesting discussion covering the operation of sub-stations. He dwelt on the importance of brush economy on rotary converters. He said the cost of maintaining brushes and commutators in a large system using rotary-converters might be very high. The cost of the brush equipment for a 2,000-kw rotary-converter was as high as $180. A 2,000-kw rotary-converter has 430 brushes. The life of direct-current brushes obtained in practice on the Chicago Edison system is now from four to five years. Brushes of a given polarity must be adjusted so that they do not track and wear grooves on the commutator. A brush tension of from 1½ to 2 lb. per brush is used, depending on the size of the brush. Brushes are treated by being boiled in dynamo oil for an hour or more. In case it is necessary to resurface a brush with sand paper, only one brush should be taken at a time. If all the brushes on the machine are sandpapered at once, excessive wear will result. The brushes on the alternating-current rings are retrimmed about once a year, and are staggered to prevent wearing grooves. In discussing the starting up of a large system of rotary-converters after a general shutdown, he described trials which had been made in which about 30,000 kw capacity in rotary-converters had been started in a few minutes from a 5,000-kw steam turbine unit, the steam turbine having been slowly brought up to speed and the rotary-converters keeping in synchronism with it.

Tax on Western Power Companies.

Mr. F. H. Short, of Fresno, Cal., has come East to represent the interests of Western electric power companies, against which, it is said, certain taxes operate unfairly. The principal purpose of Mr. Short's trip will be to secure for the San Joaquin Electric Power Company, of which he is attorney, permission to use the water supply of streams within the forest reserves without the imposition of a tax which is about to be imposed by the Interior Department. This tax will be levied as a part of the general system of making the reserves pay for the expense of maintenance by making charges against all who use them—lumber, stock and power men alike—but it is proposed to assess the tax against the power companies in proportion to the total electricity developed, rather than in proportion to the benefit received—an obviously unfair discrimination. This tax will also be opposed by the power men on the ground that as far as they are concerned it is a discrimination against Western users of rivers as contrasted with Easterners. In speaking of the matter, Mr. Short said in a recent interview:

"The question raised is an important one, both to the electric companies and to the public. It will take a great deal of money to develop the electric power available in this State and the imposition of a tax, which may be increased from time to time, would retard investments of this character and in a degree interfere with the sale of bonds. The electric companies would not object to paying for any materials or timber obtained or property actually occupied. The proposed tax, however, goes farther than a charge for the increased water supply, which the conservation service of the Government is supposed to furnish. It will amount to a direct tax upon the production of electric power wherever permits are held in the forest reservation, whether much or little of the water is obtained from these sources or not and whether any increased flow is obtained.

"From the point of view of the public, we think the charge is unequal and unjust. The rivers of the East and Middle West States are useful to the public almost exclusively for navigation purposes. They are improved and maintained for navigation at the expense of the general government, of which we pay our part. The public use of irrigation and the development of electrical power will be the principal public benefits from Western rivers. The reservoiring and diverting of the water for irrigation will render them unfit for navigation except only as to the principal rivers and as to the lower portions of these only, so that the Government will not be justified in developing them beyond these lower portions for navigation.

"If the irrigators are required to reimburse the Government for its expenditures in their behalf and the electric companies are taxed for the Government service in the forest reservations, we of the West will be paying and returning to the Government all or a greater part of the expense in connection with Western rivers and at the same time paying our part of maintaining the navigability of Eastern rivers. And, of course, ultimately this tax would become a part of the cost of producing electrical power and the public would pay most of it. This would be the same as if boats were taxed for the expenses of improving navigable rivers. The tax would necessarily be added to the freightage.

"This is the basis of the policy of improving the rivers at

national expense. Apparently the department has been trying to work out the idea of making the forest reservations self-sustaining, which is all well enough so long as it relates to the sale of timber or valuable lands permitted to be acquired or used. But when it comes to paying the expenses of maintaining and improving the flow of rivers, we are confronted with the policy of this being done at national expense where the rivers are navigable and at local expense where they are devoted to the public use of irrigation and the development of electric power. The discrimination would be clearly unjust as to Western interests and I feel confident that when it is thus understood it will not be carried out.

"The electric companies build free roads into the reservation, maintain fire breaks and assist in extinguishing fires, and where reservoirs are constructed regulate the flow of rivers, diminishing the floods and increasing the flow during dry seasons, thus aiding in all of the purposes of the Government and increasing the supply of water for irrigation. The power is also used for pumping for irrigation and will be very extensively used for this purpose in the future."

December Meeting of the Boston Branch A. I. E. E.

A meeting of the Boston branch of the American Institute of Electrical Engineers was held in the Lowell Building, Massachusetts Institute of Technology, on Wednesday evening, December 19, Prof. Clifford presiding. One hundred and fifty-eight members and visitors were present. The Forest Reserve Bill now before the Congress was brought up and it was voted: In view of the all-important influence of our forests upon the relation of rainfall to runoff and upon the regularity of flow of our streams, on which the commercial value of water powers largely depends; and in view also of the damage which may be done by floods and of the very obvious and rapidly increasing economic importance of water powers to the community, that the chairman and secretary be instructed to address an appeal on behalf of the Boston branch of the American Institute of Electrical Engineers to the members of the House of Representatives from Massachusetts urging them to petition the speaker without delay that the bill now pending, known as House Bill No. 13, which provides for the establishment of the Southern Appalachian and White Mountain Forest Reserves be taken up for final action at an early day in the present session.

The paper of the evening was given by Walter V. Turner, mechanical engineer of the Westinghouse Air Brake Company, on "The Development of the Air Brake for Steam and Electric Traction Service." Mr. Turner traced the development of the air brake from its earliest form to the most improved electro-pneumatic type in use at the present time, showing it to be one of the most important features of heavy electric traction, and that its development had kept pace with the increase in weight and speed of equipment.

At the next meeting of the branch Dr. Charles E. Lucke, of New York, will present a paper on gas engines.

American Production of Gas, Coke, Tar and Ammonia.

A report on the production of gas, coke, tar and ammonia at gas works and in retort coke ovens during 1905 has been prepared by Mr. Edward W. Parker, of the United States Geological Survey. It includes, in addition to the statistics of the production of gas, coke, tar and ammonia at gas works and in by-product coke ovens, a statement of the production of the quantity of gas and tar produced at water gas works using crude oil for enriching purposes.

The total quantities of these products in 1905 was 40,454,215,132 cu. ft. of gas (not including that lost or wasted), 5,751,378 short tons of coke, 80,022,043 gallons of tar, 46,986,268 gallons of ammonia liquor (equivalent to 22,455,857 pounds of anhydrous ammonia), and 38,663,682 pounds of ammonia sulphate, against 34,814,991,273 cu. ft. of gas, 4,716,049 short tons of coke, 69,498,085 gallons of tar, 52,220,484 gallons of ammonia liquor (equivalent to 19,750,032 pounds of anhydrous ammonia), and 28,225,210 pounds of ammonia sulphate in 1904. The total value of all these products in 1905 was $56,684,972 against $51,157,736 in 1904.

Returns were received from 477 oil and water gas producing companies, and these show that the total production of water gas in 1905 was 82,959,228,504 cu. ft. Of this quantity 5,547,203,913 cu. ft., or 6.7 per cent, were lost by leakage, etc., leaving 77,412,024,591 cu. ft. as the net production obtained and sold. As the quantity of gas made and sold at coal gas and by-product coke oven works was 40,454,215,132 cu. ft., it appears that the consumption of water gas, and gas made from crude oil was nearly twice as much as that made from coal. It also appears that while the average price of coal gas in 1905 was 81.4 cents per 1,000 cu. ft., that of oil and water gas combined was a fraction of a cent in excess of $1 per 1,000 cu. ft. Still further comparison shows that whereas 66 per cent of the production of coal gas was sold as illuminating gas, 77 per cent of the combined production of oil and water gas was used for this purpose.

Engineering Education.

The current issue of *Clarkson Bulletin* contains a symposium on "Education and the Engineering Professions," to which five members of the faculty of the Thomas S. Clarkson Memorial School of Technology contribute. One of the papers is by Dr. Byron B. Brackett, professor of electrical engineering, who discusses electrical engineering and the training it requires, from which we quote the following broad and common-sense view of one phase of the subject:

"There are certain broad fundamental principles and laws of electrical phenomena and their application which only a very unusual mind can deduce from its experiences in practical work. The things there learned are disjointed and often apparently inharmonious facts. One should begin this experience with a previously acquired general and most comprehensive view of the subject. Only through such a preparation can the variety of concrete facts gathered in practical work be welded into a harmonious whole, and thus become of greatest value to him who possesses them.

"The college course must give this broad, general outlook to the students, or most of them will never possess it. To accomplish this end much study of actual apparatus and extensive laboratory courses are needed, but the object of this experimental work is primarily to develop the required theories and to furnish some satisfactory anchorage for such theories. Practical work in connection with school training, simply because it is practical work, is greatly overestimated by the public at large and even by some teachers in technical and engineering schools.

"In the first place practical training in actual productive operations, constructive work and the like, can be given with much greater efficiency and economy of time, effort and money outside of schools. Those who are seeking that kind of training alone should not enter a school of technology of collegiate grade, or the engineering department of our American colleges and universities. Only those who desire deeper and more thorough knowledge should attempt such a course.

"In the second place the college course should aim to give that kind of essential knowledge to the engineer which he will have most difficulty in acquiring or augmenting later in life. If attention is directed entirely to those things which an apprenticeship would teach by experience, then it is no better than an apprentice course which would take less time and cost much less money. To give a large portion of the time to those things which will be most easily learned at the very beginning of later work is to misdirect the student's effort, and lose for him a most precious opportunity.

"While in college, therefore, the student should rise in some degree to this broader and more general point of view. He should become acquainted with the methods of analysis and forms

of reasoning employed to-day by the greatest minds in this field of work. He should learn to read and to understand the papers and the discussions of the engineering societies and scientific associations of electrical workers, to read and to understand the articles and descriptions published in the best engineering journals. He cannot afford to spend a large portion of his time in the petty, and for the main part, superficial observations of how to make wheels and armatures go around, or other so-called practical things. These are all very good in their proper place and to some extent must be considered in any case. Nevertheless most of the technical work and instruction of a sound and thorough engineering course must be laid on broader and deeper things, things of worth and moment, that require more mental effort and result in greater mental development."

Radiation from Gas Mantles.

In a paper read before the York meeting of the British Association for the Advancement of Science, Mr. James Swinburne discussed the various theories which have been proposed for explaining the great luminous efficiency of the gas mantle. The ordinary explanation of the high efficiency is that rare earths have a property of selective radiation, in virtue of which they send out a larger proportion of their radiant energy in the form of light than do ordinary hot bodies. Mr. Swinburne states that "the rare earths also suffer from 'luminescence,' which may be a disease of its own account or a symptom of catalysis or polarization, or something." He states that there may also be "all sorts of curious things—such as resonance, unstable oxidation and other occurrences whose names are as impressive as vague." The author expressed the belief that the simple temperature explanation fits the phenomena. "If pure thoria has low emissivity it will rise to a temperature near that of the shell of flame bathing it. Having low emissivity it will then give out little light, but the light will have a larger proportion of visible and refrangible rays. If a very little of a body with a high emissivity be added radiation will increase, but the temperature of the mantle will fall as there must be a steeper heat radiation to supply it. The total radiation is then increased, and though the proportion which is luminous will be diminished the total light will be augmented. Further addition to the emissive substance increases the total radiation and reduces the temperature until the light given is less even than with pure thoria. Almost anything colored increases the light of thoria if added in very small quantities. The reason why ceria is used is not that it has any peculiar radiating qualities. It is chosen because it is fairly permanent at the high temperatures and does not weaken or spoil the thoria mantle. The ceria of chemistry books is white, but the ceria of commerce is yellow. The light of the mantle thus may be purely that due to a hot body at a given temperature; the proportion of components of different frequencies being simply that due to the temperature. The addition of a little more ceria would then increase the emissivity and cause greater radiation, and a fall in temperature, so that the light would decrease. A decrease of ceria would diminish the emissivity so that though the mantle became hotter it would radiate less of all wave lengths.

Western Power Company Operations in California.

A subsidiary company of the Western Power Company, of New Jersey, with headquarters in New York, which is in charge of much of the California work for that company, is the Great Western Power Company, of California. Edwin Hawley is president of both companies. It is proposed to enlarge a tunnel, driven 22 years ago by Dr. Pierce, who organized the Great Bend Mining Company for the purpose of constructing a diverting dam at Great Bend and conducting the entire current of the Feather River through a tunnel 15,000 ft. in length discharging into the lower level of the stream, 15 miles away. The Great Bend Mining Company's plan embraced the diversion of Feather River through the tunnel and to allow the channel where it passes around the horseshoe bend to run dry and allow the 15 miles of river bed to be prospected for the deposits of gold supposed to lie buried in the sands. The funds of the mining company were absorbed before the ambitious project was realized and the work had to be abandoned, but not before 12,000 ft. of a tunnel through hard granite 14 ft. square, had been excavated, leaving 3,000 ft. at the lower end uncompleted. No corporation with sufficient capital to renew operations on the original plan and complete the design appeared until the Great Western Power Company, abandoning the original purpose of mining in the channel, proposed to employ the stream in the creation of hydro-electrical energy. Work has been quietly proceeding for several months.

It is proposed by the company not only to drive the tunnel through to the bank of the lower stream 3,000 ft. away, but to reconstruct it by enlarging the dimensions to 25 ft. square and to concrete the walls the entire length so as to allow the whole volume of the Feather River to flow uninterruptedly to the opening, 15,000 ft. away, and discharge with a head of 500 ft. The water will be diverted from the upper river by a dam built across the canyon.

The power plant is planned ultimately to contain 120,000 hp altogether. At first but four units will be installed, producing 60,000 hp, and it is planned to have them in operation by June, 1908.

The wheels will be of the Frances type, with vertical shafts and with the generators will be the largest ever contracted for. Water wheels with shaft and generator will weigh over 700,000 lb. each. The pressure pipes will be 5 ft. in diameter. From the power house current will be carried on transmission lines consisting of steel towers, seven towers to the mile. The elevation of the diverting dam at the upper end of the tunnel will be 1,000 ft. above sea level. The altitude of the power house is 450 ft. Progress on tunnel and buildings is progressing with all possible rapidity, some 400 men now being employed besides a large number of teams. It is the intention of the company to furnish power only in large amounts, and to lease the general business of supplying smaller services to others. It is expected that transmission will be effected to San Francisco, from which the plant is about 175 miles distant.

Chicago Traction Report.

The report submitted Dec. 10 to the Chicago Council, giving an estimate of the total value of the properties of the Chicago City Railway and Union Traction Companies, is a model of what an engineering report should be when made to an audience such as that to which it is addressed. The text is very brief considering the extent and complexity of the work to which it relates, and there is little discussion of details. The greater part of the report consists of condensed statements of the methods employed of the valuation of the tangible and intangible properties of the companies, with reasons supported by legal advice where the views of the committee did not coincide with those of the companies. Many of the problems encountered, such as those connected with the value of the franchises, cable properties, paving traffic arrangements with other companies, etc., were highly complicated and doubtless received months of consideration by the commission, but the report confines itself to a statement of the principles upon which the final valuation of these items was based.

The immense amount of work performed by and for the commission in the preparation of its report is indicated by the staff working under its direction. The commission consisted of Mr. B. J. Arnold, Prof. M. E. Cooley of the University of Michigan, and Mr. A. D. DuPont, formerly General Manager of the Detroit electric traction system. The organization of the staff working under the commission was as follows: Engineer-in-chief, Mr. George Weston; statistician, Mr. J. C. Nealy, and the following departments: Track and paving, 3 engineers and 10 assistants; overhead work, tools and supplies, 1 engineer and 4 assistants; underground conduit and cable, 1 engineer and 3 assistants; rolling stock, 2 engineers and 3 assistants; power plants, buildings, machinery, etc., 1 engineer and 13 assistants; intangible values, 2 engineers and 3 assistants; 1 draughtsman and 4 assistants; furniture, 2 experts; horses, 3 experts; real estate, 2 experts. In addition to the above force, the executive, auditing and stenographic departments of the Arnold Company were largely utilized in preparing the valuations.

CURRENT NEWS AND NOTES.

"ETERNAL LIGHT."—Mr. Thomas R. Watson, city clerk of Passaic, N. J., has sent to Mr. Edison the record of an Edison incandescent lamp in his office. It has just been removed from the socket in which it had been burning for thirteen years. After all, the old carbon filament lamp had virtues. It is thought this is about the record for longevity.

GENERAL ELECTRIC STRIKE ENDED.—The strike of the Industrial Workers of the World at the works of the General Electric Company in Schenectady was declared off on Dec. 20. The company did not recede from its position regarding the three discharged draughtsmen, which was the cause of the strike, and they will not be reinstated. The company will reemploy practically all of the men who were out on strike, and in so far as is consistent with the interests of the company will give the men their old jobs. The strikers agree to in no way annoy the men at work.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION.—The fourth convention of the Vermont and New Hampshire Independent Telephone Association will be held at Bradford, Vt., January 8, 1907. After the business meeting a number of gentlemen from other States will give interesting and instructive talks on the independent telephone situation in various parts of the United States. A banquet will be served to the members and friends of the association at Hotel Low in the evening. Mr. G. W. Buzzell, of St. Johnsbury, Vt., is secretary of the association.

TELEPHONY IN INDIANA.—The following data is a compilation of the tax reports of the Independent Telephone Companies of Indiana to the state and county officials. Exclusive of those controlled by the Bell, 351 companies report direct to the auditor of the state, while a number of systems owned by individuals are reported locally for taxation. The increase for 1906 over 1905 is also given, as follows: 1906—Number of subscribers, 182,180; capital stock issued, $9,756,480; bonds outstanding, $4,824,152; total, $14,580,632. Increase over 1905—Number of subscribers, 37,150; capital stock issued, $1,888,263; bonds outstanding, $1,086,495; total, $2,964,758.

CASTAWAY ON MIDWAY.—On September 15, 1906, the Pacific Mail Company's steamer *Mongolia*, on her way from Yokohama to San Francisco, ran on the reef at Midway Island. The American Pacific cable lands at this lonely spot. The only inhabitants are 20 employes of the Commercial Pacific Cable Company, who operate the cables, and a company of United States Marines, who guard the cables and residents from pirates. The island is very dangerous to approach at any time and the *Mongolia* struck at 10 o'clock at night. The wrecked passengers were cared for by the cable staff, who did everything possible to make them comfortable. To show their appreciation of the kindness extended to them, the saloon passengers presented the staff with a beautiful silver cup. It will be remembered that Mr. George G. Ward, vice-president and general manager of the cable company, his wife and daughter, were among the passengers. The inscription on the cup reads: "From the saloon passengers of steamship *Mongolia*, who were wrecked at Midway Island, 15th September, 1906, as a token of gratitude to the members of the Commercial Pacific Cable staff, who so willingly catered to their comfort until relieved September 23, 1906."

RAILROAD ACCIDENTS.—The Interstate Commerce Commission in its report on railroads remarks: "In the matter of long hours the accident reports have shown instances of even worse conditions than existed in former years. In the item of passengers killed in collisions and derailments the record for 1906 is not so bad as that of 1905. This is a cause for gratification; but the only real indication of the figures is that the number and severity of *great* disasters has diminished. The cost of collisions as reported by the companies, excluding damages to property and indemnities paid to or on account of persons killed or injured, is $10,659,189, nearly a million dollars greater than in 1905. The statistical tables only serve to confirm the serious and pressing character of the three-fold problem which has been made the chief feature of this department of the last two or three annual reports: (1) The investigation of accidents; (2) the requirement by law that the block systems shall be used on passenger lines, and (3) the regulation by Government authority of the evil of overwork by trainmen, signalmen and telegraph operators."

MR. B. J. ARNOLD has been appointed chairman of the board of supervising engineers to deal with the Chicago traction situation, and also chief engineer of the work of construction. The salary fixed is $30,000 per year, or $15,000 for each of the positions. The Chicago newspapers comment most favorably on the selection of Mr. Arnold for these important posts. The Chicago *Evening Post* in an editorial entitled "Bion J. Arnold's Service," says: "Men mean more than measures in a democracy. Thus the association of Mr. Bion J. Arnold with the traction agreement gives that document a trustworthiness that cannot be denied by the most maudlingly suspicious seeker after 'joker' clauses. Mr. Arnold has been to Chicago's transportation what Mr. Burnham is going to be to Chicago's civic beauty. He is at the head of his profession, and he has turned his talents toward the service of his fellow citizen. Not only as an engineer but also as a man he has always had some measure of that wonderful faith which the people bestow so lavishly upon Theodore Roosevelt. It is beyond words good that the presence of such a man gives the public every assurance that both parties to the traction bargain are acting in unquestionable good faith."

CENTRIFUGAL ELECTRICAL POTENTIALS.—Prof. E. F. Nichols, of Columbia University, has contributed to *Physicalische Zeitschrift* a report of a series of experiments undertaken to determine whether in the transfer of electricity through metals the positive ions are free and the negative fixed, the negative free and the positive fixed, or both the positive and the negative ions are free to move in opposite directions. The experiments were performed with an aluminum disc 21 cm. in diameter and 4 mm. thick driven at a speed of 100 r.p.m. Under these conditions there should be produced between the center and the rim of the disc an e.m.f. of 10^{-3} volts if the negative ions are thrown outward by the centrifugal force and 10^{-5} if the positive ions are thus moved. Special precautions were taken to eliminate possible rotational e.m.f's due to the presence of the earth's magnetic field and other causes. Since no e.m.f. having the magnitude of 10^{-5} volts was observed, the author concludes that the positive ion is at least not the sole conveyor of the electricity. The instruments and adjustments were not sufficiently sensitive to detect an e.m.f. as small as 10^{-3} volts, so that no conclusions were drawn as to the part played by the negative ion alone or in combination with the positive ion.

SAN FRANCISCO WORLD'S FAIR.—The project of holding a world's exposition in San Francisco, commemorative of the discovery of the Pacific by Balboa, has taken definite shape in the incorporation of a company with an authorized capital of $5,000,000. The exposition will also celebrate the completion of the Panama Canal. The scope of the exposition includes the promotion of interest in the arts and sciences through the medium of a great exposition, as well as interest in manufactures, the cultivation of the soil, working of the mines, preservation of the forests, and the taking of products from the sea. "To promote and encourage libraries, historical researches, sciences, information and skill among the learned professions, and the establishment of museums, aquaria, art galleries, libraries, places of amusement and recreation, and the erection of monuments in commemoration of historical events or periods," are among the other objects of the association. The company is to be known as "The Pacific Ocean Exposition Company," and of its $5,000,000 capital $14,000 has been subscribed by the following board of directors: R. B. Hale, I. W. Heilman, Jr., William F. Herrin, Rufus P. Jennings, Homer S. King, Hartland Law, William A. Magee, J. Martin, W. H. Metson, Percy T. Morgan, Charles R. Beitler, Henry T. Scott, Frederick W. Sharon, Harry L. Tevis, Fred Tillmann.

THE WIRELESS CONFERENCE.—According to cable advices from London, the discontent felt in Great Britain over the wireless telegraphy convention still prevails, and has resulted in the appointment of a select committee of the House of Commons to make a full inquiry.

ANÆSTHETIC ELECTRICITY.—It is stated that Prof. Leduc, of Nantes, gave a demonstration at the Beaujon Hospital before Dr. Tuffier of his method of utilizing electricity as an anæsthetic. Experiments were made upon animals and were absolutely successful. At the close of his demonstration the professor was warmly congratulated by those present.

LONDON POWER.—It is cabled from London that the text of the bill was published last week, which is aimed against the London County Council power scheme and seeks to unite the thirteen separate companies now supplying electricity to London, with a capital of thirteen millions sterling. The bill offers cheaper maximum rates and will allow any new company to join the combination on stated terms.

YALE NIGHT CLASSES.—It is announced that beginning with next term the Yale Scientific School will give a series of courses for workingmen, either free or for payment of a nominal fee. The courses will comprise twenty exercises of four hours a week in the evening on practical electricity, mechanical drawing, machine designing, steam and the steam engine. In the courses both employers of labor and the trades' councils will be asked to co-operate.

CUBAN COMMERCIAL CABLE.—Governor Magoon, of Cuba, has signed a decree which will become operative on January 10, permitting the Commercial Cable Company, of Cuba, to land cables from Key West. This permission is given for an indefinite period, but is not to be construed as the granting of a monopoly. The Cuban Government reserves the right to suspend the permission or to take possession of the installation whenever it may deem such action necessary for the protection of public interests.

MORE POWER FROM CHICAGO'S DRAINAGE CANAL.—President R. R. McCormick, of the Drainage Canal Trustees of Chicago, has announced that the trustees will attempt to get the necessary legislation at the next Illinois General Assembly to build a new power plant below Joliet. The plan involves the removal of the dam of the Economy Light & Power Company at Jackson Street, Joliet, and the purchase or condemnation of that company's property. The trustees are now completing a 20,000-hp plant at Lockport above Joliet.

AN UNCONSTITUTIONAL TAX.—It is interesting to note that the Supreme Court of Georgia has declared that the "occupation tax" of the general tax act of 1902 is unconstitutional. The decision was rendered as the result of proceedings instituted by the Southern Bell Telephone & Telegraph Company by which that corporation resisted the collection of $30,000 taxes under the operation of the act. In addition to a direct loss of this amount to the State, there is a loss of $150,000 in revenue as a result of the decision, which will prevent the collection of the tax from all other corporations.

GOVERNMENT CHAPELS.—An inquiry was recently submitted as to whether light, heat and power could be furnished the new chapel recently dedicated at Governor's Island, New York harbor. It has been decided by the War Department that the chapel, while erected and maintained by Trinity Parish, comes under the heading of public buildings. The Government provides quarters for the clergyman at Governor's Island and it is held that the chapel building may be heated and lighted, as are buildings which are erected by the Government for chapel purposes. General F. D. Grant, commanding the Department of the East, it is held, has the authority to prescribe the amount of fuel and electric current which should be furnished to the Governor's Island chapel.

A DEBATER WANTED.—It is proposed to have a debate at the coming convention of the Electrical Salesmen's Association in Chicago in January, on the question "Resolved, that the salesman is a more important factor in the sale of goods than his house." Needless to say there are plenty of members who will take up the affirmative side of the question, but it is desired to get some able talent on the negative; and volunteers or suggestions for possible speakers on this subject are invited by Mr. C. A. S. Howlett, chairman of the committee, who can be addressed care of the Western Electric Company, Chicago.

A. I. E. E. MEETING.—The 212th meeting of the American Institute of Electrical Engineers will be held in the Assembly Room of the New York Edison Company, No. 44 West Twenty-seventh Street, New York City, Friday, December 28, at 8.15 p.m. Mr. Ray P. Jackson, electrical engineer of the Westinghouse Electric & Manufacturing Company, of Pittsburg, will present a paper entitled "Recent Investigation of Lightning Protective Apparatus." The paper will be discussed by the following members of the Institute: Charles P. Steinmetz, Frank G. Baum, Harold W. Buck, Ralph D. Mershon, Percy H. Thomas, David B. Rushmore and H. B. Alverson.

TWAIN AT THE TELHARMONIUM.—Last week Mark Twain visited the Cahill telharmonium plant, on upper Broadway, New York, and heard the music through a "singing arc" as well as by the telephone. He was greatly pleased and remarked: "The trouble about these beautiful novel things is that they interfere so with one's arrangements. Every time I see or hear a new wonder like this I have to postpone my death right off. I couldn't possibly leave the world until I have heard this again and again. If a great princess marries, what is to hinder all the lamps along the streets on her wedding night playing that Lohengrin wedding march together? Or if a great man dies here—I, for example—they could all be tuned up for a dirge."

TELEPHONE ON LONG ISLAND.—The extension of telephony all around Greater New York is as striking as its progress within the city. The telephone is now being used as an index of the growth (either in population or progressiveness) of Long Island. Two or three years ago all of Oyster Bay's telephone service was handled by one young woman. Of night service there was none. Now five young women are kept constantly busy during the day and two at night, even when the President is not at home. Huntington, a village eight miles from Oyster Bay, handled all the telephone calls two years ago through one switchboard, managed by one operator. Five young women now are needed and two at night. Similar telephone growth has been noted in other sections. Increases of from 50 to 400 per cent are to be found in most of the villages. This, it is argued by real estate men, is a sure indication of the growth of Long Island and a prophecy of its future. In Brooklyn itself the rate of growth is very rapid, but of course comes under urban conditions.

SUPERFLUOUS ANIMALS.—The horse was long since superfluous, a nuisance and a "sanitary crime" in cities, but will remain an industrial necessity until the electric or gasoline automobile knocks him out as the trolley has expelled him from the car tracks. Some idea of the way horses throng the streets is afforded by the statistics of Mr. T. J. Cavanagh as to Chicago. Exclusive of stock yards teaming, 100,000 trucks move in the business district daily. There are employed 325,000 men in driving, unloading and caring for the teams. More than 150,000 tons of freight are hauled through the downtown streets daily, exclusive of the tunnel and South Water Street traffic. Freight carried across town has trebled in fifteen years. The investment in trucks, teams and equipment exceeds $60,000,000. About 75 per cent of the trucking is done through teaming companies. Team drivers and helpers receive $250,000 daily in wages, and this figure is doubled by including the wages paid to the men who load and unload. Here is some of the business awaiting the courageous automobile manufacturer.

ALASKAN CABLES.—Advices from Seattle state that Wrangel, on the southwestern coast of Alaska, is now for the first time in telegraphic communication with the outside world. On December 21 Lieut.-Col. Glassford wired the local offices of the United States Signal Corps that the *Burnside* had made shore connection at Wrangel and that the office there was open for business. Leaving Wrangel the *Burnside* will proceed to Ketchikan, stopping at Hadley. The extension to the Alaskan cable now being made by the *Burnside* is the first work to be carried on by the Government out of the fund created by setting aside a part of the cable receipts. Ketchikan is the first American port of entry on the southeastern coast and Wrangel is the transfer point for the Stickeen River.

MARRIAGE IN HIGH LIFE.—We have already noted some of the advertising methods adopted in Peoria, Ill. A telegram of December 22 from that city notes another as follows: "With a howling gale blowing around them, Carroll Applegate and Miss Alta Gale, of this city, were married yesterday at the top of the new 200-ft. concrete smokestack recently built for the Peoria Gas & Electric Company, and the ceremony was witnessed by thousands of spectators from the ground. Police Justice Fox performed the ceremony, and twelve persons witnessed it on top of the stack. The party was transported to the top in a bucket. The affair was the occasion of the dedication of the stack. One week ago the company advertised that it would present to any couple married on top of the new stack a gas stove, fixtures for their home, $25 and pay the minister's fee. Seven couples applied, but Mr. and Mrs. Applegate were first."

CHICAGO ELECTRICAL SHOW.—Mr. Homer S. Niesz, of the Chicago Edison Company, has been visiting New York the past week in the interest of the Chicago Electrical Show, which promises to be an even greater success next January than it was in 1906. There are already nearly 200 exhibitors and an attendance of 150,000 people, paying admission, is counted on. The following "special events" have been fixed: Telephone Day, January 21; Benj. Franklin Day, January 17; Thomas A. Edison Day, January 23; Electrical Salesmen's Association, Thursday, January 24; Northwestern Electrical Association Convention, January 16, 17 and 18. Meetings at the Coliseum. All the latest inventions and novelties will be included and Mr. Niesz hopes to plan for the transmission of music currents from the Cahill telharmonium plant to the show, at least experimentally, on some of the nights.

WIRELESS FOR CONGRESS.—A wireless telegraph station has been erected upon the grounds of the Capitol at Washington under the supervision of Elliott Woods, superintendent of the Capitol, who, in connection with his other duties, has devoted a good deal of attention to perfecting wireless apparatus which he expects to be of service if Congress should authorize the maintenance of the station as part of the facilities for communication between the Capitol and the outside world to supplement the telegraph and the telephone. In order to demonstrate the serviceableness of the wireless station established at the Capitol, Mr. Woods has invited some of the members of Congress to visit the place during the holiday recess and to send and receive messages. Congress has made no appropriation thus far for the station, but the superintendent of the Capitol has been encouraged to go ahead with the work, and there seems to be a likelihood that, with the great building improvements now under way on the Capitol plaza, the wireless telegraph station will be authorized as a regular part of the equipment. It is expected that there will be times when wireless communication from the Capitol would be of value to Congress. and the sending of messages relating to the proceedings in the House and Senate when some topic of vital moment is under discussion is a not unlikely development of the future. During the President's trip to Panama on the battleship *Louisiana* the Capitol wireless station was constantly in touch with the ship, hearing practically all the messages exchanged.

MUNICIPAL OWNERSHIP RESPONSIBILITY.—The Indiana Supreme Court, in the case of the city of Richmond vs. Lincoln, has decided that when a city engages in the business of operating an electric light plant for commercial as well as municipal purposes, through the agency of electric light commissioners chosen by the city council, the city is liable for injuries or death caused by the negligent operation of its machinery and wires exactly as a private company would be. The rule of exemption does not apply in such case. In like manner the Court of Appeals of Kentucky has just reversed a lower court and ordered a new trial for the plaintiff in a suit for personal injury against the city of Somerset. The court held that it is the duty of one engaged in furnishing electric light to have the insulation perfect where persons have the right to go, so that a city is liable on evidence that it installed an electric globe and received compensation for the light, and that an employe of the one for whom it was installed was injured because of poor insulation, in warming his hands about the globe, he not being a trespasser.

MAY NOT DIVERT CANADIAN WATER.—A recent dispatch from Ottawa says: "The International Deep Waterways Commission has reported against the application of the Minnesota Canal Power Company, of Duluth, for authority to divert certain waters from Birch Lake drainage basin in Lake and St. Louis Counties, Minn. If granted it would materially affect the water level in Rainy River, New Ontario. The City of Winnipeg, the town of Fort Francis, the Ontario & Minnesota Power Company, E. W. Backus, holder of certain power concessions from the Ontario government, the Koochiching Company and the Rainy River Improvement & Navigation Company all resisted the application. The commission suggested the adoption of a treaty between the United States and Canada to settle rules and principles to govern the diversion of international waterways, but recommended that such waters be used freely by both sides for navigation purposes and for locks used for purposes of navigation." The people in the Rainy Lake country are very well satisfied with the result because the granting of the concession would have meant the loss of practically all water power on the Canadian side of the line.

PERFORMANCE IN TRAIN LIGHTING.—Prof. F. W. Huels, of the department of experimental engineering at the University of Wisconsin, presented a paper before the Western Society of Engineers at Chicago, December 19, 1906, entitled, "Vibrations in passenger trains from high-speed electric lighting engines." This paper gave the results of tests for vibration on trains of the Chicago, Milwaukee & St. Paul and the Chicago & Northwestern Railways running between Chicago and Minneapolis. The vibration recorder used to make these tests was illustrated and described. The instrument is something like the seismographs used for registering the shocks and undulatory motions of earthquakes. Tests were made on trains having a Westinghouse high-speed engine in the front end of the baggage car for driving the lighting dynamo and also on trains with the dynamo in the rear end of the baggage car. Tests were also made on trains equipped with 25-kw Curtis turbine generators. The records presented showed considerable vibration in the different cars of the train equipped with the high-speed engine lighting set when standing at a station with the buffer springs under compression. With the draft rigging under tension as in starting a train, the vibration falls off very much. In the discussion which followed the paper, Prof. Huels said that the steam consumption of the turbine was a little higher than that of the high-speed engine. Some curves giving the results of steam consumption tests were on exhibition after the close of the discussion. These curves showed that the lowest steam consumption obtained under the conditions of the tests was in the neighborhood of 60 lb. per kw-hour. The difference in the steam consumption of the engine and turbine under working conditions is not very great. A steam consumption of over 100 lb. per kw-hour under the every-day working conditions would seem to be not at all unlikely from the curves shown in the paper.

Single-Phase Light and Power Plant at Belleville, Ill.

THE plant of the Belleville Gas & Electric Company is notable as one which has adhered to single-phase generation and distribution for light and power even though it is of a size in which polyphase generators are usually found. The company has for many years had a 500-volt, direct-current power service. Like many other companies, it found, several years ago that it must invest considerable money in feed-wire copper to extend and enlarge its 500-volt power service or must begin to supply power from its single-phase lighting circuits; or, as a third alternative, must put in a polyphase distributing system for power purposes.

Belleville is an Illinois city of about 20,000 inhabitants, in which are located a great many manufacturing industries, foundries being especially numerous. These industries are very much scattered, being located everywhere along several railroads passing through the town. This would have made it necessary to invest an undue amount of money in feed wire if the scattered power business was to be taken care of by 500-volt, direct-current service. The adoption of a polyphase distributing system would also have involved expensive changes in generating and distributing systems. It was therefore decided to adhere to the single-phase system, using in all cases the same feeders for light and power. The single-phase motors used are principally of the Wagner type, although some motors of the General Electric and Westinghouse makes are also connected.

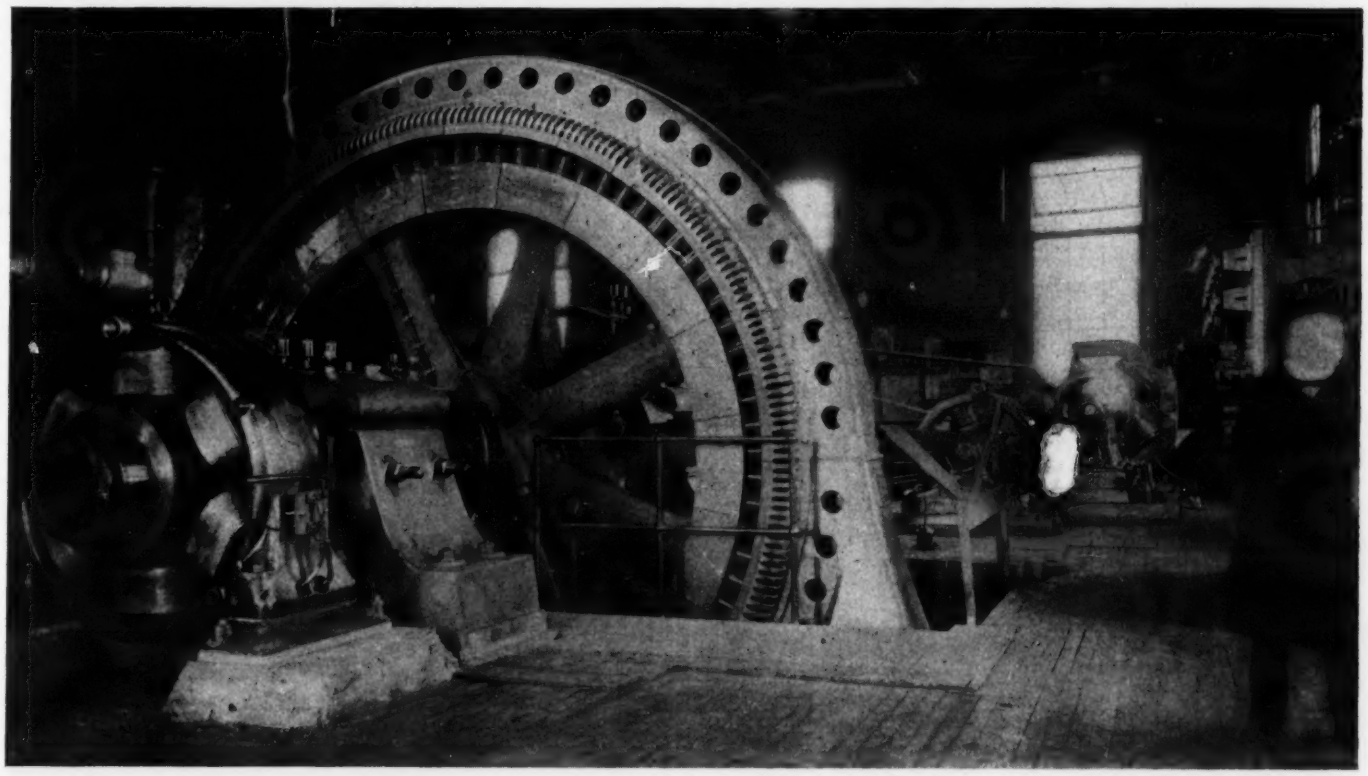


FIG. 1.—500-KW, SINGLE-PHASE ALTERNATOR, BELLEVILLE, ILL.

THE POWER PLANT.

The most recent addition to the generating equipment is a 550-kw, 2,300-volt, 60-cycle, Allis-Chalmers, single-phase generator running 90 r.p.m., shown in Fig. 1, direct-connected to a Reynolds simple Corliss engine, 30 by 48 in., and with the exciter on the same shaft. There is also one 300-kw, single-phase, General Electric generator direct-connected to a Hamilton simple Corliss engine, 22 by 30 in., running 120 r.p.m. This generator also has the exciter on the same shaft, and belted from it is a 90-kw, 500-volt, direct-current generator. A Russell engine 20 by 27 in. has a 120-kw, single-phase generator belted from it and also a 200-kw, 500-volt, direct-current generator. Another Russell engine 15 by 20 in. is to be belted to a 150-kw, 500-volt generator. While much of the company's power output at the present time is through 500-volt, direct-current generators, the 500-volt system is not being extended.

All new business is taken on the single-phase alternating circuits, and some business has even been changed from 500-volt, direct-current, to single-phase alternating because of the better voltage regulation on the alternating circuits and also because of the automatic character of the Wagner single-phase motors used, which makes it unnecessary to start up a motor by hand should the power be cut out temporarily. The connected load in motors in August, 1905, was 774 hp, of which 600 hp was in direct-current motors. In November, 1906, the connected load was about 900 hp, of which about 500 was in direct-current motors.

The boiler room equipment consists partly of Abendroth & Root water-tube boilers and partly of horizontal return flue boilers. Coal mines are located near Belleville, so that coal is cheap. An unusual arrangement for handling ashes has been installed. Ashes are dumped at one end of the boiler room, into a hopper at the bottom of which is a conveyor, which carries the ashes out some distance from the power house where they are either discharged into a pile or into a wagon underneath the discharge pile. The conveyor is operated by means of a motor. Fig. 2 shows the outdoor end of the arrangement of the ash-conveying system.

LOAD AND OUTPUT.

Some typical load curves for 24 hours are given herewith. The curves for June 5, 1905 and 1906, shown in Fig. 3, were selected as representing the light load period of the year. Those for October 23, 1905 and 1906 (Fig. 4), represent medium conditions. That of October 27, 1906 (Fig. 5), shows Saturday night load conditions. That for December 21, 1905 (Fig. 6), shows the load during the winter peak period of last year. The output in kw-hours is given on each of these curves.

The connected load consists now of about 900 hp in motors, 218 street arcs, 190 constant-potential commercial arcs and the equivalent of 4,500 16-cp incandescent lamps. The company owns the gas plant and gas light is extensively used in Belleville, which accounts for the very low incandescent load. The gross income from power is now about equal to that received from private consumers of electric light. The lighting rates are 15 cents per kw-hour, less certain discounts to the large consumers if bills are

paid on or before the sixth of the month. The power rates are six cents per kw-hour, also subject to discounts according to quality, if paid before the sixth of the month. No power contract is taken for less than $2 per month, and if over 4 hp is connected, the minimum is 50 cents per month per horse-power. No

FIG. 2.—ASH CONVEYOR, BELLEVILLE CENTRAL STATION.

discount is given on a power contract for a consumption of less than 100 kw-hours. From 100 to 200 kw-hours the discount is 10 per cent; from 200 to 300 kw-hours, 20 per cent, and so on up to 500. Between 500 and 1,000 the discount is 40 per cent, and for more than 1,000, 50 per cent, so that a very large long-hour consumer would get a rate of 3 cents per kw-hour. Lighting consumers whose bills are less than 25 cents per 16-cp lamp connected get no discount. For a consumption of 25 to 50 cents per month per lamp the discount is 10 per cent; for 50 to 75 cents, 20 per cent; for 75 cents to $1, 30 per cent, and over $1, 40 per cent. The minimum bill is 75 cents per month. Lamp renewals are furnished at 15 cents each in order to keep out the sale of inferior inefficient lamps in the town by retail dealers. In order to give an idea of the character of power service which this company has connected, the following is a partial list of the in-

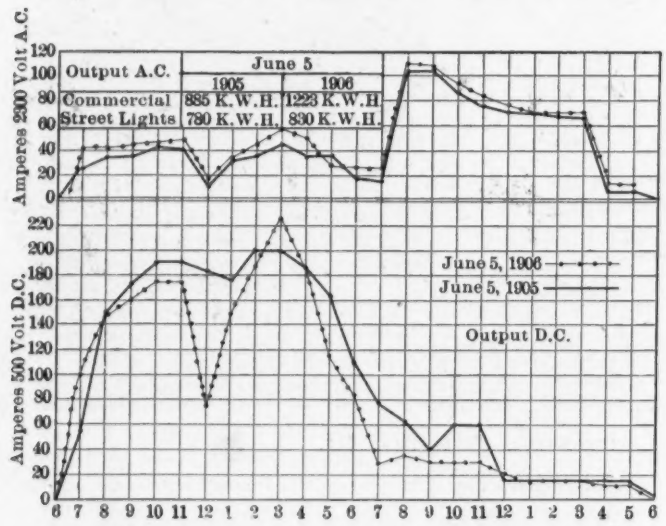


FIG. 3.—BELLEVILLE LOAD CURVES, JUNE 5, 1905 AND 1906.

dustries supplied with power and the number of customers of each kind.

Foundries	7	Shoe repair shops	3
Planing mills	6	Telephone exchanges	2
Newspapers and printing offices	8	Underwear factory	1
Coal mines	3	Bottling works	2
Brick yards	2	Organ blowing	2
Grain elevators	3	Freight and passenger elevators	8
Flour mills	3	Meat markets	11
Bakeries	3	Laundry	1
Machine shops	2	Ice factory	2
Shoe factories	2		

Fig. 7 shows a Wagner single-phase motor used at a brickyard for driving a centrifugal blower for drawing air through the kilns while they are drying out and is given to show the character of surroundings in which many motors have been operating. It is found by drying out in this way much time can be saved in the production of a kiln of brick. In some brickyards, although not in this one, such blowers are used for taking air from the kilns which are cooling down and exhausting it into the kilns which are being dried out and about to be warmed up. The

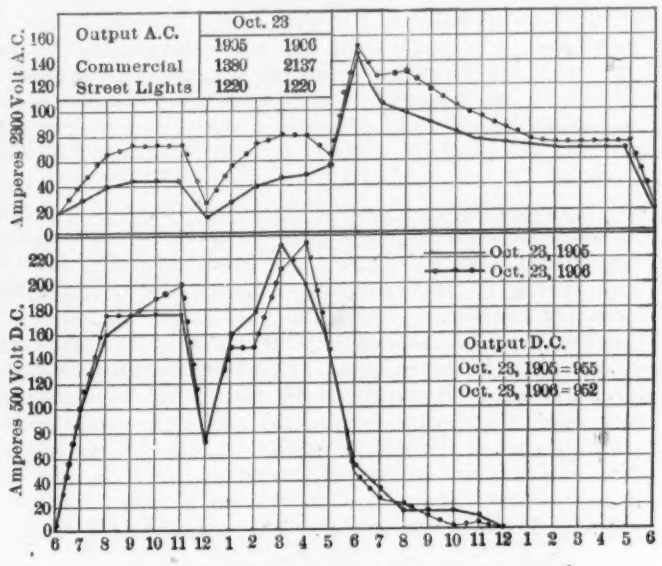


FIG. 4.—LOAD CURVES OCTOBER 23, 1905 AND 1906.

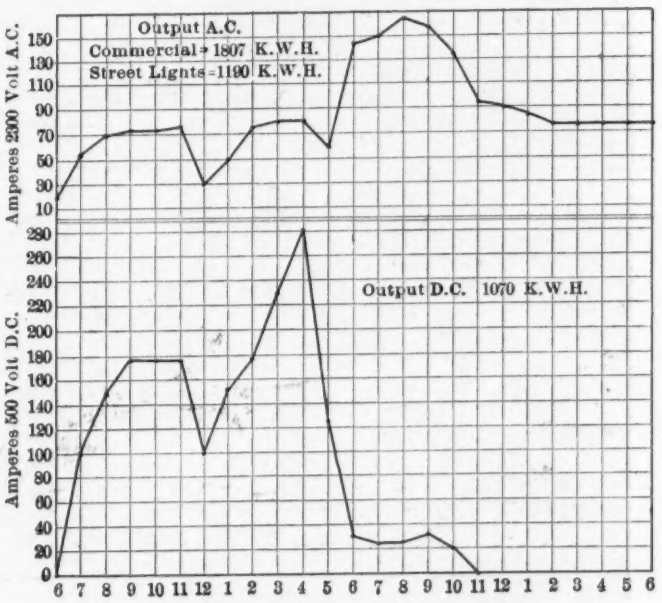


FIG. 5.—LOAD CURVES, OCTOBER 27, 1906.

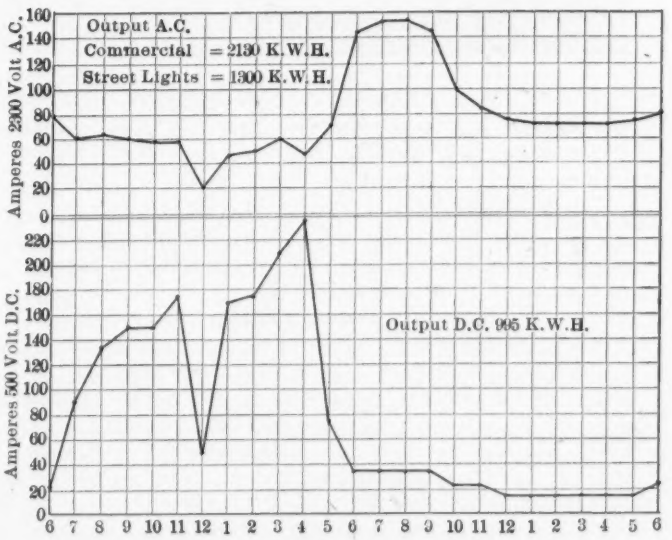


FIG. 6.—LOAD CURVES, DECEMBER 21, 1905.

economy of motor drive is pronounced in brickyard work because of the scattered places in which power is required. For

example, this motor takes the place of a steam engine connected to a long line of steam piping, which was very wasteful and gave much trouble. This motor is in a shed in one corner of the yard and requires no attention beyond starting and stopping and oiling. The largest single-phase motor in use is of 30 hp.

In connection with the public service of the city the water company which obtains its supply from wells scattered over the city is doing its pumping electrically at some of its wells. A motor is also used at the city sewage pumping station. The city also

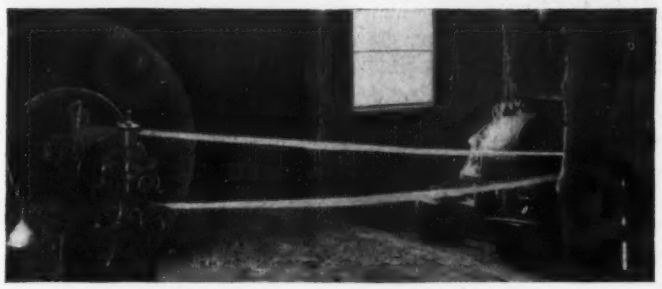


FIG. 7.—BLOWER MOTOR IN BRICKYARD SHED.

has a 3-hp motor driving a compressor to supply compressed air to the city street sprinkling wagons. The company's power business is not considered to be by any means fully developed.

The property is under the management of Mr. Harry B. Kircher. Next year a solicitor will be employed for the gas and electric business, but of course most of the power business is to be handled personally by Mr. Kircher, since the greater part of power business will from now on consist in replacing isolated steam plants. It is the intention to establish a flat rate sign and display lighting circuit the coming year, taking contracts on a flat rate which will give the company about 7 cents per kw-hour for electricity used.

A Noteworthy Example of Modern Illuminating Engineering.

The artificial lighting of the engineering laboratories recently dedicated at the University of Pennsylvania affords an excellent example of the results obtained in that growing branch of the electrical art—illuminating engineering. Every room in this modern structure has been the subject of careful determination from the lighting standpoint, the selection of lighting units and

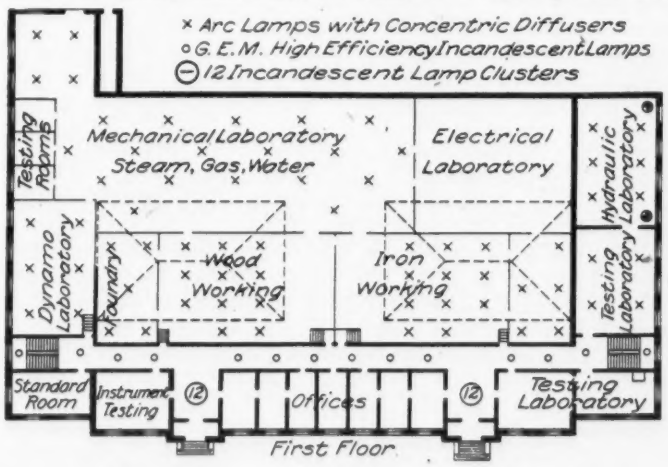


FIG. 1.—ARRANGEMENT OF LIGHTING UNITS ON FIRST FLOOR.

the efficacy of the illumination being given in the accompanying tables and illustrations.

Both arc and incandescent lamps are used in combination, arc lamps of the enclosed type with concentric diffusers being employed for illuminating the larger areas, while high-efficiency incandescent lamps with shades and ordinary incandescent lamps, mounted singly and in clusters, have been adapted for lighting hallways, lecture rooms, etc.

The new building, with basement and three stories of rooms having various lighting requirements, presents a nice problem for the illuminating engineer, and the installation, because of this varied character, is typical of modern lighting practice. Within the building are machine shops, drawing rooms, laboratories, offices, lecture rooms and library, each group exacting certain lighting values.

The basement, containing rooms for storage, lockers, etc., is lighted by ordinary incandescent lamps and requires no special mention. On the first floor, however, the illuminating plans are

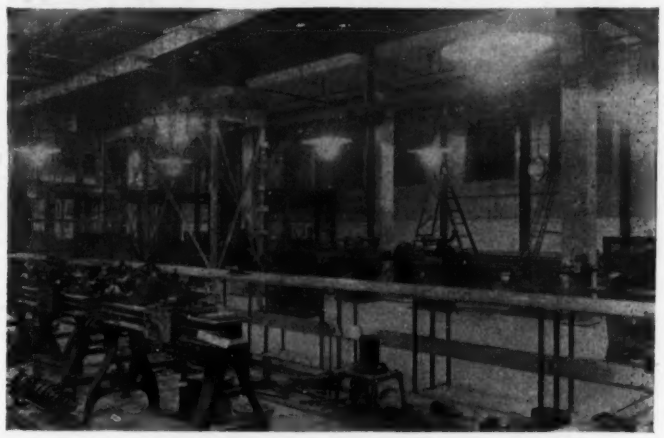


FIG. 2.—MACHINE SHOP ILLUMINATED WITH ARC LAMPS.

noteworthy. Here are located the principal mechanical and electrical laboratories and the shops, as well as various small laboratories and offices. The mechanical laboratory, with heavy machinery and wide open spaces, requires a general brilliant illumination with the light so diffused as to prevent shadows behind machines. For this purpose 5-amp., 110-volt, direct-current enclosed arc lamps have been installed of the type equipped with concentric diffusers. The diffuser consists of a circular sheet-iron reflector, in the form of a broad inverted cone, the white enameled surface being corrugated in concentric circles, designed so as to distribute the light from the arc below to best illuminate the floor beneath.

In the wood-working, iron-working and forge shops, and in the dynamo, testing and hydraulic laboratories, on the first floor, conditions prevail similar to those obtaining in the mechanical laboratories. Arc lamps with concentric diffusers are, therefore, used, arranged as in Fig. 1. The excellence of this illumination

FIG. 3.—HALLWAY LIGHTED BY INCANDESCENT LAMPS.

can be seen in Fig. 2, which has been reproduced from the original photograph taken by the light of the lamps. The absence of shadows and the even distribution of the light are particularly marked. Scattered incandescent lamps are available for lighting parts of machine and work.

The hallways form another problem in lighting which in this instance has been interestingly worked out by the use of high-efficiency incandescent units combined with a concentrating reflector. The units are of the No. 4 Gem type, consuming 187

watts and concentrating 180 cp in a downward direction by means of No. 5 Holophane Pagoda reflectors. This method of lighting is well adapted to the long, comparatively narrow corridors. The excellent results thus obtained are indicated in Fig. 3.

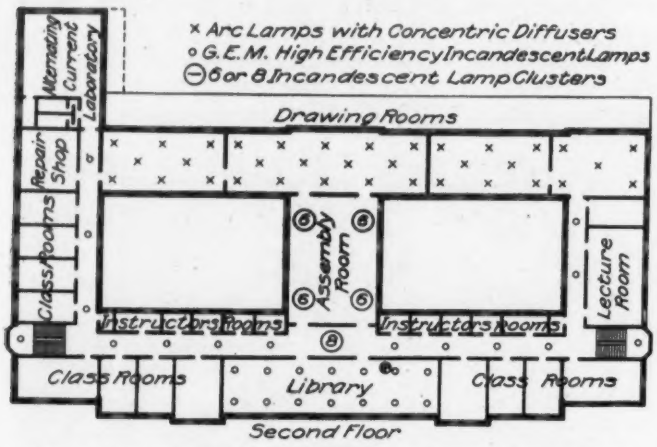


FIG. 4.—ARRANGEMENT OF LIGHTING UNITS ON SECOND FLOOR.

In Figs. 4 and 5 are shown the lighting plans of the second and third floors, respectively. On these floors the drafting rooms present the most interesting feature. From the nature of the case, the illumination in these rooms must be brilliant and

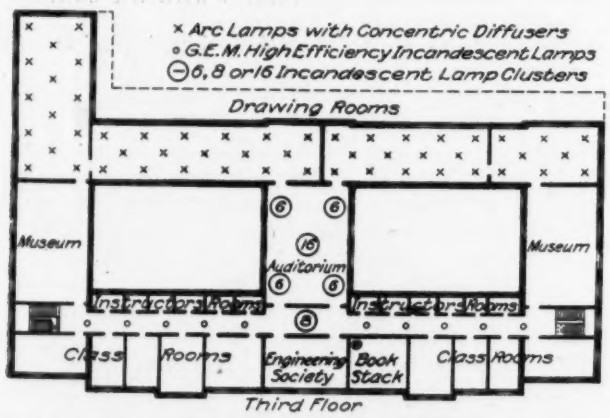


FIG. 5.—ARRANGEMENT OF LIGHTING UNITS ON THIRD FLOOR.

well diffused, so that work can be done accurately by artificial light. The enclosed arc lamp with concentric diffuser has been selected for this purpose with the result shown in Fig. 6. The various illustrations were taken from night photographs;

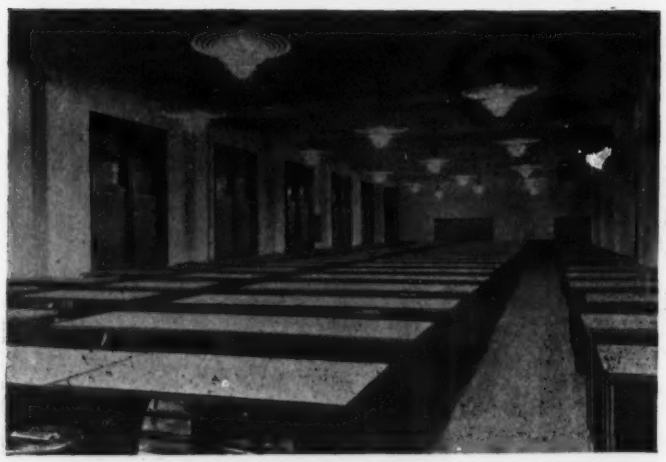


FIG. 6.—DRAFTING ROOM LIGHTED WITH ARC LAMPS WITH CONCENTRIC DIFFUSERS.

the sharpness of the illumination obtained combined with the evenness of the distribution is striking.

In addition to the drawing-rooms, other rooms on the second and third floors incorporate instructive features in illuminating engineering. The assembly room on the second floor is lighted by four six-lamp incandescent clusters, located as shown in Fig. 4. The illumination so produced is soft and even, the chief requirement being a soft general illumination which does not distract the eyes. The library on the same floor is lighted by Gem units, as are the halls on this floor and in the first story. The light here is stronger than in the assembly room, but at the same time it is soft, well diffused and restful, quite in keeping with the purpose of the room.

On the third floor are the museums and auditorium, both lighted by incandescent lamps arranged in clusters. General illumination is, of course, the chief requisite here. The hallway on this floor is lighted by Gem units.

In order to make the comparison of illuminating values more convenient, the accompanying tables have been prepared showing the character and dimensions of the room, the unit of illumination, and the watts per sq. ft. It will be seen that the drawing-rooms require the greatest amount of light, averaging 2.65 watts per square foot, while the shops come next with an average of 1.8 watts per square foot of floor area. With these figures as a basis it would be quite possible to determine the amount of electricity necessary to light any building satisfactorily to meet different conditions, providing the floor areas were known. The above-described lighting equipment was installed by the General Electric Company, Schenectady, N. Y.

TABLE I—FIRST FLOOR ILLUMINATION.

Room.	Unit of illumination.	Dimensions of room, ft.	Watts per sq. ft.
Mechanical laboratory	22 arc lamps with concentric diffusers		
	Main	162x63	1
	Bay	37x39	
Electrical laboratory	2 high-efficiency, 187-watt Gem units, 94 16-cp incandescent lamps	72x63	1.22
Dynamo laboratory	6 arc lamps with concentric diffusers, 18 16-cp incandescent lamps	62x38	1.82
Work shops	52 arc lamps with concentric diffusers, 42 16-cp incandescent lamps	213x51	1.84
Hydraulic laboratory	6 arc lamps with concentric diffusers, 13 16-cp incandescent lamps	63x38	1.68
Testing laboratory	14 arc lamps with concentric diffusers, 11 16-cp incandescent lamps	46x38	1.6
Testing laboratory offices, standard room, etc.	84 16-cp incandescent lamps	6,300 sq. ft.	.72
Corridors	14 high-efficiency, 187-watt Gam units, 24 16-cp incandescent lamps	3,741 sq. ft.	1.05

TABLE II—SECOND FLOOR ILLUMINATION.

Room.	Unit of illumination.	Dimensions of room, ft.	Watts per sq. ft.
Drawing room	18 arc lamps with concentric diffusers	58x31	2.45
	14 " " " " "	93x31	2.68
	8 " " " " "	58x31	2.45
	5 " " " " "	46x31	1.92
Library	14 high-efficiency, 187-watt Gem units	98x28	1.0
Assembly room	24 16-cp incandescent lamps	44x63	.48
Corridors	12 high-efficiency, 187-watt Gem units 8 16-cp incandescent lamps	11x300	.81

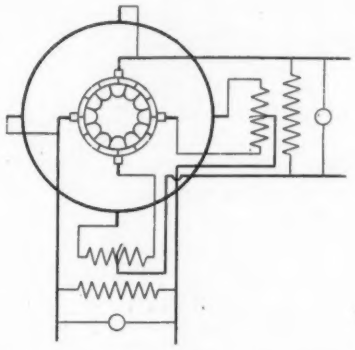
TABLE III.—THIRD FLOOR ILLUMINATION.

Room.	Unit of illumination.	Dimensions of room, ft.	Watts per sq. ft.
Drawing room	14 arc lamps with concentric diffusers	87x38	2.33
	17 " " " " "	116x31	2.6
	13 " " " " "	80x31	2.88
	9 " " " " "	59x31	2.7
Museums	24 16-cp incandescent lamps	62x39	.55
Auditorium	40 16-cp incandescent lamps	2,772 sq. ft.	0.8
Corridors	10 high-efficiency, 187-watt Gem units 8 16-cp incandescent lamps	11x300	.7

Self-Exciting Alternator.

Our issue for September 15 contained an article by Mr. G. Faccioli describing an interesting self-exciting alternator designed by Mr. William Stanley, in which the voltage generated at one pair of brushes on the commutator is used to supply the exciting current for the field which caused the generation of e.m.f. at another set of brushes. It was shown that in order to overcome the ohmic drop in the field coils due to the two separate magnetizing currents, it is necessary to apply to the energizing circuits of the machine electromotive forces in phase with such currents. Methods of using a separate revolving-field trans-

former and of shifting the brushes to obtain the required result were discussed. A patent issued December 11 to Mr. William Stanley discloses the method shown in the accompanying illustration, which dispenses with the special rotating-field transformer and yet makes it unnecessary to have any displacement of the brushes. The two auxiliary transformers are so wound that the electromotive forces produced at the secondaries are substantially in quadrature to the electromotive forces produced in the respective rotor and stator windings. The secondary electromotive forces have the proper time-phase positions



STANLEY SELF-EXCITING ALTERNATOR.

and are given the proper values to send the exciting currents through the resistance of their circuits. The arrangement shown is particularly advantageous where the conditions are such that both the stator and the rotor windings are supplying substantially equal amounts of power to the mains, since for load-currents flowing equally from both the rotor and the stator circuits the magnetizing forces set up by the load-currents in the two halves of the secondaries are equal and opposite, and thus neutralize one another.

On an Approximate Measurement, by Electrolytic Means, of the Electrostatic Capacity Between a Vertical Metallic Cylinder and the Ground.

BY A. E. KENNELLY AND S. E. WHITING.

IT is well known that every problem of the electrostatic capacity of a condenser formed by any pair of conducting surfaces, and separated by a uniform insulating medium, is equivalent to a corresponding problem of the electric conductance between the same, similarly placed, pair of surfaces, separated by a uniform conducting medium. The solution of either of such a pair of problems immediately leads to the solution of the other.

If, therefore, we desire to predetermine the capacity of a pair of conductors in definite geometrical relation, when the computation cannot be effected by ordinary rules, we may construct a model of the geometrical system, either on the same dimensional scale as the original, or upon a conveniently reduced scale, substitute a uniform conducting solution for the dielectric, and measure the conductance between the conductors as electrodes. This conductance will correspond to, and determine, the capacity of the original system considered.

As an example, we may consider the familiarly simple case of a condenser formed by two opposed parallel metallic discs of diameter very large compared with the distance between them. If the surface of each disc be s sq. cm. and the distance between them be l cm., the well-known formula for the capacity of the system, ignoring the irregularity at and beyond the edge of the discs, is:

$$C = \frac{\kappa}{4\pi} \cdot \frac{s}{l} \qquad \text{centimeters or abstatfarads,} \quad (1)$$

where κ is the specific inductive capacity, or inductivity, of the medium, and C is the capacity in absolute electrostatic units, which may be abbreviated into "abstatfarads."

The conductance offered between the same, similarly situated discs, separated by a conducting medium of conductivity γ mhos per centimeter is well known to be

$$g = \gamma \cdot \frac{s}{l} \qquad \text{mhos,} \quad (2)$$

where γ is numerically equal to the conductance of a centimeter—cube of the medium between any pair of parallel faces, or

$$\gamma = \frac{1}{\rho} \qquad \text{mhos per centimeter,} \quad (3)$$

where ρ is the resistivity of the medium in ohm-centimeters, and is numerically equal to the resistance of a centimeter cube of the material between any pair of parallel faces, expressed in ohms.

The capacity in abstatfarads, or centimeters, of the dielectrically-separated system is, therefore, related to the conductance in mhos of the conductively-separated system by the formula:

$$C = \frac{\kappa}{4\pi\gamma} \cdot g \quad = \frac{\kappa\rho}{4\pi} \cdot g \qquad \text{abstatfarads.} \quad (4)$$

This formula is quite general in application, and is not limited to the particular case of plane parallel discs above considered. The two conductors may have any form and relative disposition. If g is expressed in abmhos, γ must be expressed in abmhos per centimeter and ρ in absohm-centimeters.

If the pair of conductors on which the measurement of conductance is made, be a perfect model of the condenser n times reduced in linear scale; so that every centimeter in the actual condenser is represented by $1/n$th of a centimeter in the conductance model; then we know that the conductance of the model will thus be reduced n times below the value that would be obtained with a system of full size. Consequently, if g' be the observed conductance of the small model, the value of g to use in formula (4) will be

$$g = n\,g' \qquad \text{mhos.} \quad (5)$$

If the capacity of a system of conductors is capable of being readily computed by known formulas, it is unnecessary to resort to a conductance measurement. If, however, the geometrical system of the condenser is too complex to permit of a computation being made, it may be convenient to avoid constructing the actual condenser, and to construct in its place a small scale conductance model, for use in connection with formula (4). The capacity may then be reduced to its value, C_{abf}, in "abfarads," or absolute electromagnetic units, by the relation,

$$C_{abf} = \frac{C}{v^2} = \frac{C}{9\times 10^{20}} \qquad \text{abfarads,} \quad (6)$$

where v is the speed of electromagnetic waves in free ether (3×10^{10} cm. per second). In practice however, we generally desire to know the value of the capacity in farads, C_f; micro-

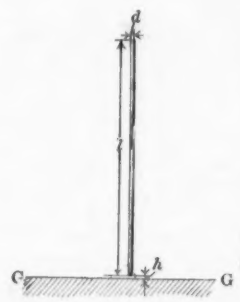


FIG. I.—DIAGRAM REPRESENTING A LONG VERTICAL CYLINDER OF LENGTH l AND DIAMETER d, SUPPORTED AT A SMALL ELEVATION ABOVE AN INDEFINITELY EXTENDED CONDUCTING PLANE.

farads, $C_{\mu f}$; milli-microfarads, $C_{m\mu f}$, or micro-microfarads, $C_{\mu\mu f}$, according to the magnitude considered, as follows:

$$C_f = C_{abf} \times 10^9 = \frac{C}{9\times 10^{11}} \qquad \text{farads} \quad (7)$$

$$C_{\mu f} = C_f \times 10^6 = C_{abf} \times 10^{15} = \frac{C}{9 \times 10^5} \text{ microfarads} \quad (8)$$

$$C_{m\mu f} = C_f \times 10^9 = C_{abf} \times 10^{12} = \frac{C}{900} \text{ milli-microfarads} \quad (9)$$

$$\text{and } C_{\mu\mu f} \times C_f \times 10^{12} = C_{abf} \times 10^{21} = \frac{C}{0.9} \text{ micro-microfarads} \quad (10)$$

The capacity of a condenser formed by a long conducting cylinder, supported perpendicular to, and not far away from, an

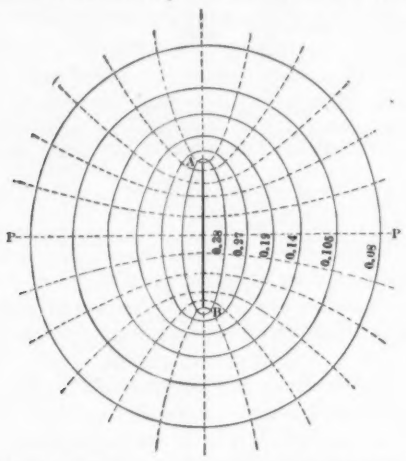


FIG. 2.—ELECTRIC POTENTIAL AND FLUX CONTOURS SURROUNDING A CHARGED ROD IN FREE SPACE, CONSIDERED AS THE LIMITING CONDITION OF AN ELLIPSOID.

indefinitely extended horizontal plane surface, does not seem to have been worked out mathematically. This case is of practical interest, since it corresponds substantially to that of a cylindrical vertical antenna, or aerial, in wireless telegraphy. The geometrical conditions are indicated in Fig. 1. A conducting cylinder of radius r cm., or diameter d cm. and length l cm. is insulated from the level conducting surface of the ground, $G\,G$, by a vertical distance h cm. The length, l, is large with respect to h and d.

It is known that the capacity of a long straight cylinder of length l cm. and radius r cm. in free space, remote from other

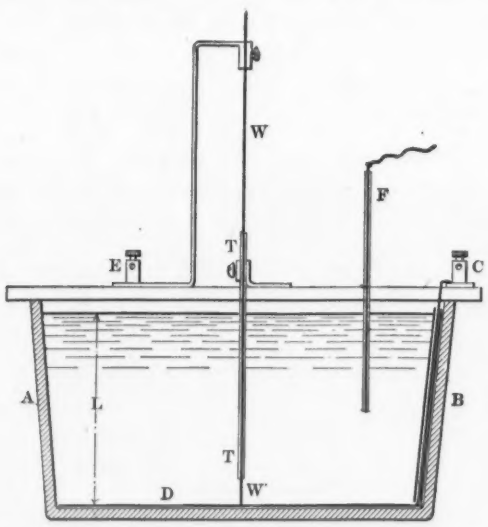


FIG. 3.—SECTIONAL ELEVATION OF THE CONDUCTANCE-MODEL.

conductors, may be computed as the limiting case of an ellipsoid of revolution by the formula:

$$C = \frac{l}{2 \log_e \frac{l}{r}} \text{ abstatfarads.} \quad (11)$$

This is the formula frequently used for estimating to a first approximation the capacity of a cylindrical vertical in wireless telegraphy, of the type indicated in Fig. 1. The distributions of electric flux and potential around such a limiting ellipsoid, remote from other conductors, are represented in Fig. 2, where $A\,B$ is the thin vertical cylinder, with a length of 100 diameters. The equipotential surfaces are confocal ellipsoids of revolution, and are confocal ellipses in section, as shown. Their successive potentials are 38, 27, 19, 14, 10.5 and 8 per cent of the potential of the axial ellipsoid, or vertical wire. The dotted lines repre-

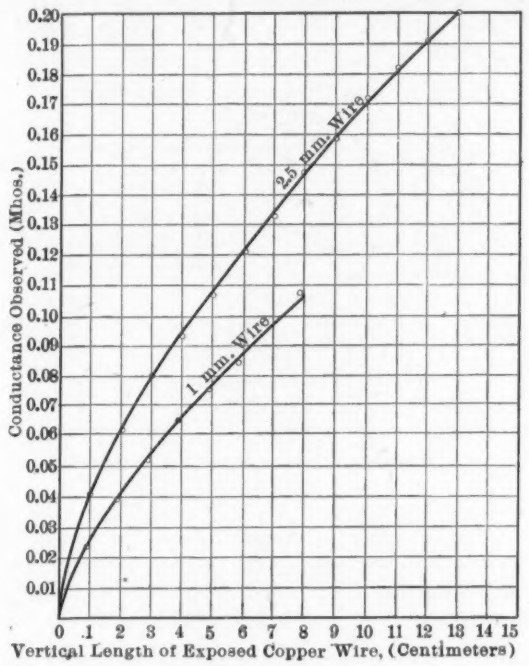


FIG. 4.—CONDUCTANCES OBSERVED WITH DIFFERENT LENGTHS OF VERTICAL WIRE EXPOSED.

sent electric flux paths and are confocal hyperbolas. It is evident that the flux is directed equally above and below the plane $P\,P$.

On the other hand, if we bring the wire $A\,B$ close to the ground, as indicated in Fig. 1, the distributions of flux and potential become disturbed. The flux becomes denser in the lower portion of the system near to the ground and the equipotential surfaces are squeezed together underneath the wire, as shown in Fig. 6.

It seemed desirable to ascertain experimentally how far the

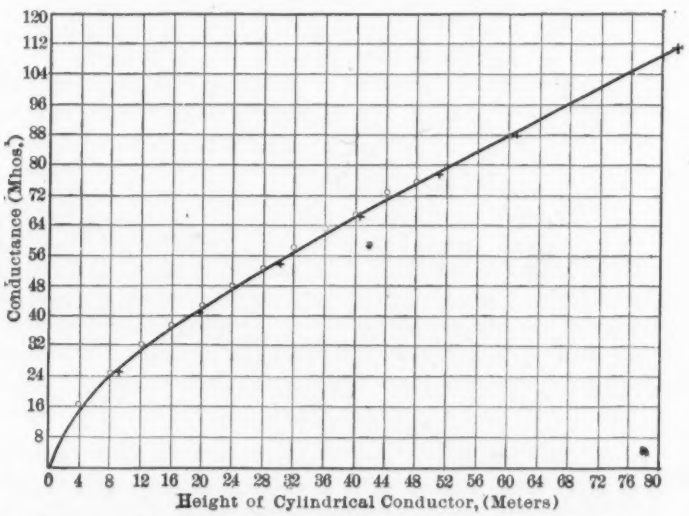


FIG. 5.—CONDUCTANCES REFERRED TO A CYLINDER 1 METER IN DIAMETER.

capacity is increased above the value given by formula (11) when different lengths of insulated vertical cylinder are employed at short distances above the ground. Instead of attempting to make these measurements of capacity on a reasonably large scale, with cylindrical conductors out of doors, a small-scale conductance model was used in the laboratory, with copper electrodes immersed in a large tub containing dilute copper sulphate solution. The arrangement of the model is represented to scale in Fig. 3. $A\,B$ is a tub of fibrous insulating material. At the bottom was

placed a disc, *D*, of copper, 54.2 cm. in diameter and 1.59 mm. thick, connected by an insulated wire to a terminal, *C*. A vertical copper wire, *W W*, connected to terminal *E*, rested on the center of the copper disc, being insulated from the same by a small flake of mica. A glass tube, *T T*, fitting fairly closely to the wire, *W W*, could be moved up and down or clamped at any position, so as to expose any desired length of the wire, *W W*, to the solution which filled the tub up to the level, *L*.

The specific gravity of the copper sulphate solution was 1.03 at 10° C., and the measurements were made at temperatures near to 10° C. The resistance between the vertical wire, *W W*, and the disc, *D*, was measured by Wheatstone bridge using the terminals *C E*. Readings were taken to "false zero," or polarization-current zero on the galvanometer scale, so as to minimize the disturbing influence of polarization e.m.f. on the observations. The measurements were made with two vertical wires in succession. The first had a diameter of 2.5 mm. and the second a diameter of 0.965 mm. The results are given in the curves of Fig. 4, in which the abscissas represent the lengths of the exposed vertical wire, and the ordinates the observed conductances; or the reciprocal of the resistances observed by Wheatstone bridge, after correcting for leads. Thus, with 13 cm. of the 2.5-mm. wire exposed, the conductance observed was 0.20 mho.

In order to bring the two series of observations of Fig. 4 into comparative relation, each is referred for convenience to an enlarged model supposed to have a cylinder diameter of 100 cm. The values given in Fig. 4 are referred to this particular assumed size of model by the formula (5). The results appear in Fig. 5, where the circles represent conductances derived from the 2.5-mm. wire, and the crosses represent conductances derived from the 1-mm. wire. The two sets of conductances are seen to

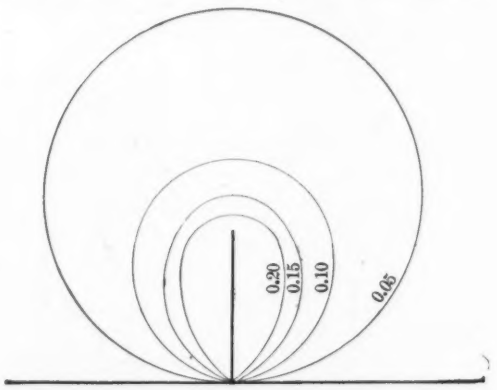


FIG. 6.—APPROXIMATE CONTOURS OF EQUIPOTENTIAL SURFACES SURROUNDING VERTICAL CYLINDER CONDUCTOR. LENGTH OF CONDUCTOR, 10 CMS.; DIAMETER OF CONDUCTOR, 0.25 CM.; DISTANCE FROM CONDUCTING PLATE, 0.2 CM.

be in fair agreement, and the curve is intended to represent them jointly. Thus a vertical cylindrical conductor 80 meters in height and 100 cm. in diameter, insulated from a correspondingly enlarged horizontal disc, and deeply immersed in the same copper sulphate solution, would offer a conductance of 108.8 mhos.

The resistivity of the solution was measured in two ways: First, by filling a glass tube 23.5 cm. long, and 1.129 cm. in mean internal diameter, with the solution, and plugging the ends with rubber stoppers, carrying copper-plated faces connected to the Wheatstone bridge by insulated wires, and measuring the resistance of the column of solution in the tube after its temperature had become practically the same as that of the solution in the tub. Second, by suspending a copper-plated brass sphere, of radius 0.95 cm., in the solution, by an insulated wire, at a measured height above the center of the disc in the tub of solution, and measuring the resistance between the sphere and disc by Wheatstone bridge to "false zero." The results by these two methods agreed satisfactorily, and the mean was taken of $\rho = 99$ ohm-cm.

Table I gives a comparison of the capacity in air to ground of a vertical cylinder of various lengths according to formula (11), and also as inferred from the conductances indicated in Fig. 5 reduced by the use of formula (4). The first column gives the height of the cylinder. The fourth column gives the capacity of the cylinder according to formula (4). The fifth column gives the capacity of the cylinder as deduced from conductance measurements with the tub model. The last column gives the ratio of these two capacities. It is evident that the conductance model

TABLE I.

Capacity of a Vertical Cylinder to Ground, in Air, According to the Formula for a Remote Ellipsoid, as Compared with Measurment on the Small Conductance-Model. Diameter of Cylinder, 100 Centimeters.

Cylinder Height l cms.	$\frac{l}{d}$	$\frac{l}{r}$	Ellipsoidal capacity c abstatfarads.	Capacity deduced from model c' abstatfarads.	Ratio. $\frac{c'}{c}$
8,000	80	160	788.0	857.8	1.089
7,000	70	140	708.3	775.8	1.095
6,000	60	120	626.4	696.2	1.111
5,000	50	100	542.8	615.0	1.133
4,000	40	80	456.4	529.8	1.161
3,000	30	60	366.4	436.0	1.190
2,000	20	40	271.0	333.5	1,230
1,000	10	20	166.9	217.6	1,304

must give larger capacities than those obtained by the ellipsoidal formula, if the conductance measurements are reliable; because the capacity of the cylinder must be greater near the ground than in free space remote from other conductors. According to these measurements, however, the capacity of a cylinder 80 diameters in height is only 8.9 per cent greater near the ground than in free space, while even if the height be reduced to 10 diameters, its capacity is only 30 per cent greater near the ground than in free space.

The fact that the increase in capacity of a long cylinder is not very large when brought near to the ground at one end is explained by an examination of Fig. 2, which shows that the fall of electric potential due to ϕR drop, where ϕ is the electric flux and R the dielectric resistance, is relatively large in the immediate neighborhood of the cylinder. If the first ellipsoidal shell, marked as having a potential 0.38 of that at the cylinder, were grounded, so as to reduce its potential to zero, the capacity of the cylinder would only be increased 61.3 per cent, and in that case the cylinder would be virtually brought near to the ground at all points and not merely at one end. Consequently, when the ground is brought near to the cylinder at one end only, the increase in capacity must be much less than 61.3 per cent.

The conductance measurements in this case did not admit of a high degree of precision for several reasons. Firstly, because the dimensions of the copper disc at the bottom of the tub were too small to represent the effect of an indefinitely extended plane. The conductances and their deduced capacities, were, therefore, somewhat too small, especially for the greatest lengths of exposed wire. Secondly, it is difficult to avoid errors in the measurement of a resistance containing a c.e.m.f. of polarization, even when working to polarization-zero. Moreover, if the polarization varies with the current density, some variation of the polarization e.m.f. may have developed at different portions of the exposed surface. Consequently, the conductance measurements here presented may be several per cent in error. However, the results may be safely regarded as indicating that in the case of a vertical insulated cylinder near the ground, having a length of a hundred or more diameters, its capacity will be only a few per cent greater than that obtained by the use of the ellipsoidal formula (4).

By means of the exploring electrode, *F* (Fig. 3), consisting of a copper wire sealed in a glass tube, and adjustable in its position relatively to the immersed wire, *W*, the potential distribution in the liquid could be explored. The observations, as far as a potential of 20 per cent of the potential at the vertical wire, *W*, are outlined in Fig. 6.

Underground Electric Oscillations.

A recent issue of the London *Electrician* contains a note on a demonstration in London of Poulsen's system of wireless telegraphy with undamped electric oscillations. As the result of recent experiments it is stated that with a power of about 1 kw perfect communication during day and night has been established between Copenhagen and North Shields, a distance of 530 miles 150 of which are overland, with a height of mast of only 100 ft. This result tends to strengthen Poulsen's previous conviction that transatlantic communication should be readily obtained with a power of about 10 kw.

Electrical Ignition in Internal Combustion Engines—III.

By F. W. Springer.

COMPARATIVE TESTS OF JUMP SPARK COILS.

THE accompanying curves, showing the instantaneous values of the primary and secondary currents of jump spark coils, were made by means of a Duddell double high-frequency oscillograph. The connections were arranged as indicated in the circuit diagram of Fig. 1.

A number of different coils of different makes were tested

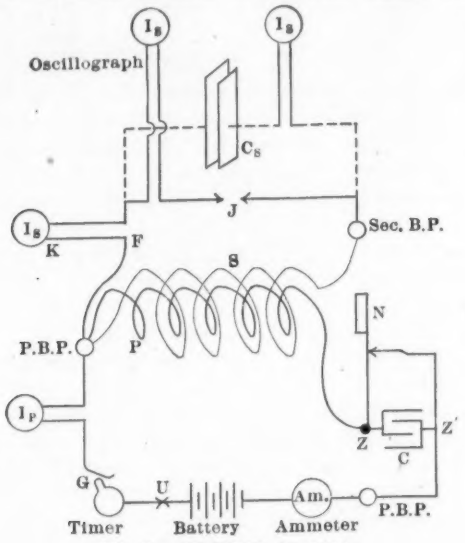
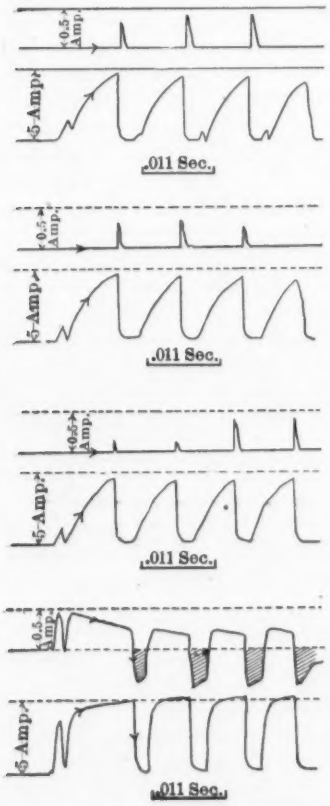
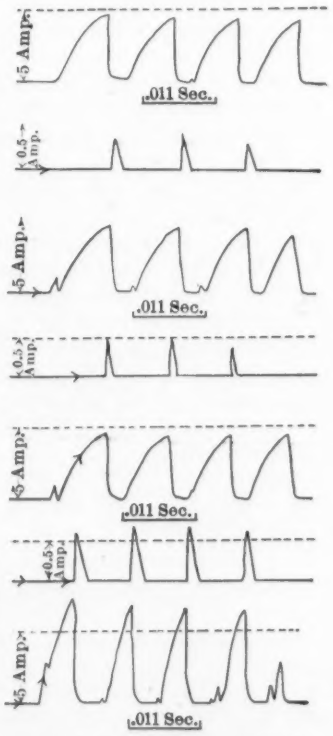


FIG. I.—CIRCUITS OF COIL.

under the same conditions. The adjustments of the vibrators, the spark gap, the voltage of the storage battery and other conditions were determined arbitrarily by the experimenter; in so far as the above selections affect the operation of the coils,



FIGS. 2, 3, 4 AND 5.—OSCILLOGRAPH RECORDS.



FIGS. 6, 7, 8 AND 9.—OSCILLOGRAPH RECORDS.

the results as shown in the curves should not be taken as necessarily showing any particular coil as being ineffective. They are all capable of producing excellent results when properly adjusted and operated under the conditions for which they were intended. It is well known that a very slight change in vibrator adjustment or slight difference in battery voltage will often produce a great difference in the effectiveness of the spark for reasons explained in a preceding paper. These points should be kept in mind when inspecting the figures.

TABLE I.—DATA OF COILS.

Coil No.	Primary resistance.	Sec. coil resistance.	P. self-inductance.	Sec. self-in.	Condenser free Cap	Remarks.
I	.45	2548	.0043	20.8	.16 m.f.	Loiseaux Brunet Freres 1905 coil, hammer blow vibrator.
II	.45	4404	.0024	23.1	.34	Ditto — 1906 model, with improved vibrator - hammer blow.
III	.47	4673	.0027	27.4	.37	Ditto.
IV	.33	4288	.005	43.8	.405	Old style plain vibrator, with heavy iror head. Splitdorf.
V	.40	3906	.00607	36.4	.387	Ditto.
VI	.30	3659	.00308	35.5	.29	Pittsfield plain vibrator, light head, stift spring, very fast.
VII	.49	3970	.0039	37.3	.089	Conn. Tel. & El. Mfg. Co.; same style as VI.
VIII	.38	2450	.0016	13.3	.58	Panhard, hammer blow vibrator.
IX	.48	4107	.00405	35.3	.24	Splitdorf automobile coil; hammer blow.
X	.46	11900	.0099	84.5	.314	Induction Coil Co. non-vibrating coil.
XI	.47	12300	.0103	86.5	.287	Ditto.
	.33 armature		.0033 armature			Ruprecht magneto-dynamo. A.C.

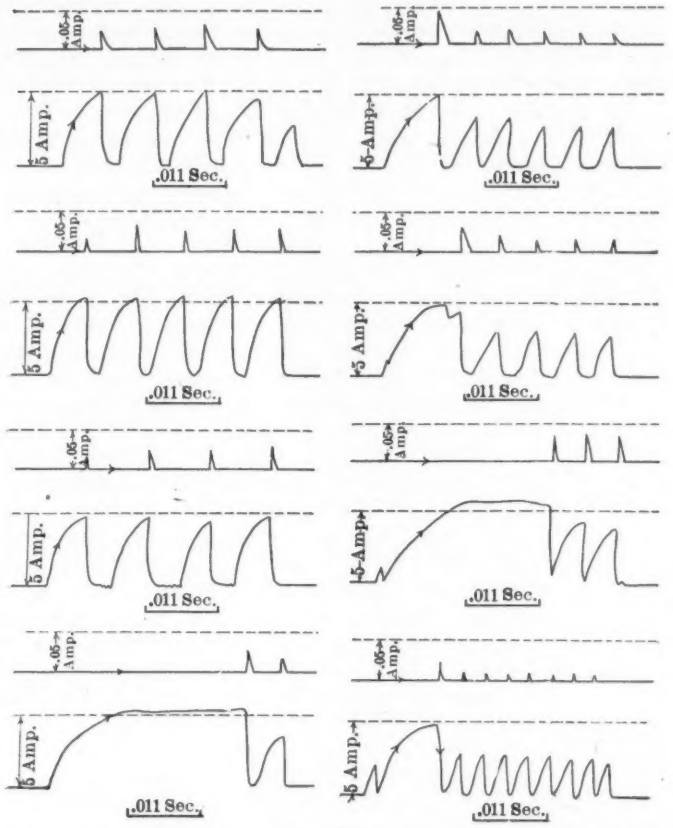
NOTE.—The resistance of the battery and primary wiring, exclusive of the primary coils, in all tests was .7 ohm.

TABLE II.

Coil No.	Fig. No.	Open battery volt.	Av. prim. I; steady buzzing.	Length of spark gap in in.	Max. spark distance in air, in in.	Remarks.
I	2	6.2	1.9	.25	.5 gap.	The last primary wave broken at contact maker and not by vibrator, hence no spark—arc held slightly on contact maker.
I	3	6.2	1.9	.25	.5	Condenser A in parallel with gap. See Table I.
I	4	6.2	1.9	.25	.5	Condenser $\frac{A}{2}$ in parallel with gap. See Table I.
I	5	6.2	2.1	0	.5	Secondary short circuited — shaded part the usual spark current inverted.
I	6	6.2	1.9	∞	.5	Open secondary — c.f. primary wave forms.
I	7	6.2	1.9	.125	.5	This negative not retouched to bring out lines.
I	8	6.2	1.9	.40	.5	To compare primary wave forms —long gap—narrow secondary wave forms. See Fig. 7.
I	9	12.4	—	.25	—	Double battery voltage; compare Fig. 2 also.
II	10	6.2	2.5	.25	.5	
II	11	6.2	—	.40	—	Compare Fig. 10 and Fig. 11.
III	12	6.2	1.9	.25	.68	
IV	13	6.2	.85	.25	.36	Slow starting heavy vibrator—but fast after starting.
IV.	14	6.2	.85	.25	—	Readjusted vibrator to start better. See Fig. 13.
IV	15	6.2	.85	.25	—	Repeated. Fig. 14—vibrator uncertain in starting, bad igniter lag.
V	16	6.2	.9 to 1.2	.25	—	Ragged tone to vibrator.
VI	17	6.2	.7	.45	.47	
VI	18	6.2	.7	.25	.47	Note the smaller secondary spark on Fig. 17 because of the larger spark gap.
VII	19	6.2	1.0	.25	—	Vibrator slow in starting.
VII	20	12.4	—	.25	—	Double voltage — compare with Fig. 19.
VIII	21	6.2	2.5	.25	.4	Large average and max. primary current.
IX	22	6.2	2.2	.25	.53	Noise like a sam will-slow coil.
X	23	6.2	—	.25	—	Non-vibrating spark coil — contact made too long a time on primary.
X	24	6.2	—	0	—	Short-circuited secondary.
X	25	6.2	—	∞	—	Open secondary — compare primary wave forms of Figs. 23, 24 and 25.
XI	26	6.2	—	.25	—	Compare secondary waves of Figs. 26 and 27.
XI	27	—	—	Very Short.	—	Fig. 27 has a very short gap—about 1/64-in.
I	28	6.2	1.9	.25	.5	Showing primary current and storage battery voltage with coil in operation. Note the battery voltage variation.
	29	—	—	—	—	Voltage curve of Ruprecht alternating-current igniter magneto

Note.—Secondary voltage was measured by the striking distance between points in air.

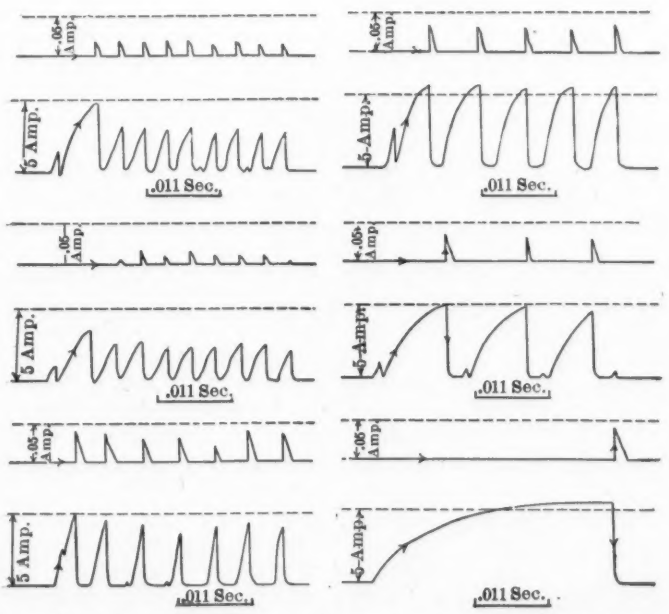
Table I. gives the coil data, including the resistance, and self-induction of the primary and secondary coils and the free discharge capacity of the paraffine condenser in each. The plate speed and the current scale values are indicated on each illustration.



FIGS. 10, 11, 12 AND 13.—OSCILLOGRAPH RECORDS.

FIGS. 14, 15, 16 AND 17.—OSCILLOGRAPH RECORDS.

The condensers referred to in Table II, in connection with coil I, Figs. 3 and 4, as A and $\frac{A}{2}$ are as follows:



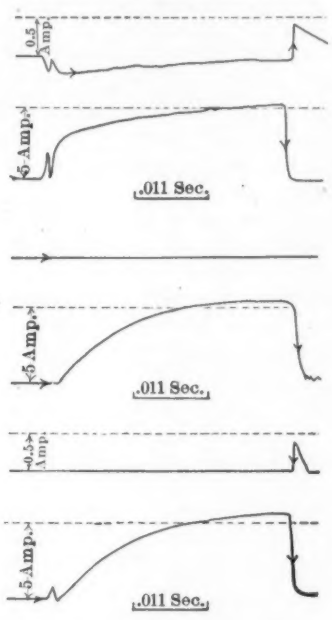
FIGS. 18, 19 AND 20.—OSCILLOGRAPH RECORDS.

FIGS. 21, 22 AND 23.—OSCILLOGRAPH RECORDS.

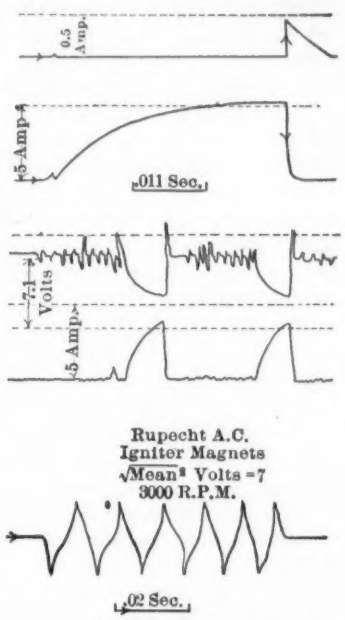
Condenser A had one dielectric of common window glass 3.2 mm. thick, the two tinfoil plates being 6.6 cm. by 3.14 cm. area. Condenser $\frac{A}{2}$ had the same dielectric and the tinfoil plates 3.3 by 3.14 cm. area, i.e., ½ the area and capacity.

The above high tension condensers were connected in parallel with the spark gap as indicated in Table II and as shown in Fig. 1.

Table II gives the data of the test and calls attention to some



FIGS. 24, 25 AND 26.—OSCILLOGRAPH RECORDS.



FIGS. 27, 28 AND 29.—OSCILLOGRAPH RECORDS.

important features. In studying the curves, comparisons might be made on the following basis. (See Table II.) 1. The height and area of the spark curves, I_s, i. e., the size and disruptive power of the spark. 2. Smallness of the area of the primary current curves, steepness of the building-up part of the primary curves. 3. Verticality of the drop in the primary current, I_p. 4. Shortness of the base of the primary curve, i.e., amount of igniter lag. 5. Smoothness of the primary curve, i.e., the lack of vibrator chattering. 6. Number of vibrations per second. 7. Average and maximum demand on the battery.

Isolated Electric Plants for Country Residences and Farms.

BY PUTNAM A. BATES.

THE many advantages offered by the electric current in connection with the lighting of our homes and the many other conveniences to which it lends itself so well, are causing a growing demand for a reliable and reasonably economical source of electrical energy for use on the larger estates and farms throughout our suburban and country districts, where electricity from a public service electric plant either is not available, its cost is excessive or the construction work necessary to bring the electric wires to the point where the energy is required, in such a manner as not to mar the beauty of the surroundings, is excessively costly.

Within the last few years the small internal combustion engine and the electric storage battery for stationary service have been so much improved and simplified as to cause them to compare very favorably with the better known types of power producing apparatus in reliability of operation and in first cost. The extreme simplicity of both this type of engine and of the storage battery, together with the very great economy in fuel consumption of these engines, the low price of the fuel, and the efficiency of the battery as a device for storing the energy and delivering it in the form of electric energy when needed and in the quantity required result in a very low operating cost. The advent of tax free alcohol into the field of available fuels for use in internal combustion engines will be watched with interest by those concerned in this problem, and while it is too early as yet to make any predictions, this fuel has already given promise

of, in time, becoming a strong competitor of kerosene and gasoline in this field.

There is still another promising source of power for these small plants which is too often overlooked. That is the small water powers which are scattered through the country, most of which could be easily developed, at small expense, and many of which have already been developed for commercial purposes, abandoned because of changed conditions, and require simply the addition of the electrical apparatus to make them valuable sources of electrical energy. Such a water power plant could frequently be made to serve a group of users of electricity at very small first cost for each individual, and at an operating cost per kilowatt hour which would be almost nil.

It is, therefore, evident that the means are at hand by which those not reached by a reliable and low-priced electric service may still avail themselves of electric energy and obtain the many conveniences which it contributes, at a cost which should seldom exceed that of an equivalent service from a public service electric plant at the rates ordinarily prevailing, for such service, throughout the country.

It must not be lost sight of, however, that very much depends upon the design of these small isolated plants and the manner in which they meet the requirements of the equipment which they are intended to supply.

This suitability to the requirements is even more important in these small plants, where the load conditions are practically fixed, than in the much larger public service plants where the load is much more elastic and may, to a considerable extent at least, be controlled and shaped to meet the capabilities of the power plant equipment by the selling organization of the owners. Many small power plants have been abandoned as unsatisfactory and extravagant, or as luxuries of questionable worth, after a short period of operation, or are being run at excessive cost and with little satisfaction merely because the apparatus is there and no other source of electrical energy is at hand, for no other reason than that the apparatus installed is not of the type or quality required for satisfactory generation of electrical energy or that the capacities of the various units of the plant equipment are not well suited to each other or to the load conditions to be met.

For this reason it is very inadvisable to decide this question in any off-hand manner, or, after having decided upon the installation of a power plant, to leave the details of its equipment to the contractor, for, no matter how honest he may be in his dealings with the purchaser, the planning of such work is out of his line and he cannot afford to give it the time which it requires, nor has he the facilities for doing engineering work of this nature.

There are three distinct classes into which the conditions which make an electric plant desirable may be divided, and each requires special treatment and a different proportioning of the units forming the power plant equipment. These are, the comparatively small place, requiring energy mainly or entirely for lighting, where the average evening load does not exceed twenty-five or thirty 16-cp lamps and where current supply from a public service plant is not available, or where the cost of connection to such supply would involve an outlay comparable to the first cost of an isolated plant; the medium-sized place, where the demands for electric power are greater and more varied and where electric energy cannot be purchased at a low rate; and the large mansion, where the evening lighting load is very heavy, but constitutes almost the entire demand for current, and where it is possible to make connection with the public service and obtain, at reasonable rates, such energy as is required when the dynamo is not running, or to help out the dynamo upon special occasions.

In order to meet the first of these conditions successfully and keep the cost of the energy within reasonable limits, it is necessary so to design the plant and proportion its apparatus that it will be unnecessary to charge any amount for labor against the cost of producing the electricity.

This is evident from the fact that the amount of energy is so small that should its generation require the employment of any labor in addition to what would be required for carrying on the other necessary work about the place, the expense of this additional labor, necessarily charged against the cost of power generation, would increase this cost beyond what would be permissible.

This requirement is met by installing a storage battery of sufficient capacity, when fully charged, to supply all ordinary demands for energy for a period of two to three days and a dynamo of suitable size for charging the battery at its normal rate, driven by an internal combustion engine or water wheel, if water power is available.

The combined output of the battery and dynamo must, of course, be sufficient to supply the maximum load that the plant will ever have to carry. This condition, however, will usually be very satisfactorily met by an installation comprising a battery and a dynamo which fulfill the other capacity requirements just mentioned.

A power plant of this general description requires absolutely no attention other than an occasional brief inspection, except when it becomes necessary to charge the battery or when there is a special demand for current. The operation of charging the battery requires only occasional attendance upon the plant, and while this must be given regularly, a very large proportion of the attendant's time may be put in at his regular duties while the battery is charging.

The dynamo for this plant should be of the variable voltage type with compound field winding, capable of operation directly upon the line as a compound wound machine, or of operating as a shunt wound machine, when used for charging the battery, delivering current to the battery at any required voltage up to forty per cent above normal. By this means the expense of a booster is eliminated without going to the other alternative of dividing the battery and charging through a resistance, which is not only an inefficient method of operation but also requires either a larger dynamo and engine or a doubling up of the time necessary for charging.

A very vital point to be considered in connection with any plant operating a storage battery is the regulation of the voltage at which the current supplied by the battery on discharge is delivered to the line. Some means must be provided by which this voltage will be kept constant or cause to vary slightly in proportion to the load carried, under all conditions of loading and wholly independent of the decrease in the voltage of the battery itself as its charge is converted into electrical energy and withdrawn.

There are a number of ways in which this may be done, but, for a plant of this description, where a minimum of attention is essential and yet where the voltage regulation must be as nearly perfect as it is possible to have it, the most satisfactory method of regulating the voltage is by means of a variable resistance placed in series with the battery and automatically operated through the medium of a relay connected across the line.

This relay may be differentially wound so as to produce an overcompounding effect and in this way overcome the loss and pressure between the switchboard and the lamps, and also allow of the operation of the battery and dynamo in multiple, in the same manner that two compound-wound generators may be operated. Such a voltage regulator can be obtained at a cost entirely commensurate with that of other methods of controlling the voltage and the results obtained, in a plant of this nature, are far more satisfactory.

The second condition, where the demand for electrical energy is greater and more varied, calls for an equipment similar in its nature to that just considered, but the proportioning of the units and the method of operation should be different.

About a place of this kind it is usually very advantageous and often necessary to have what is ordinarily known as a handy man, who is more or less familiar with the machinery, its care and operation. Such a man is almost indispensable for the care and operation of automobiles, launches, labor saving machinery about the place, the heating apparatus in the residence, green houses and other buildings, and the general upkeep of the various mechanical and electrical devices.

Such a man may readily and to great advantage be placed in charge of the care and operation of the power plant, as this will require so little attention as not materially to increase his duties. This being the case, it is better to operate the plant

during the evening, supplying the current for the lamps directly from the dynamo and thus avoid the loss of energy which is necessarily brought about when this peak load must be supplied indirectly through a storage battery.

To carry out this idea the dynamo with its engine or water wheel should have sufficient capacity to enable it to supply the ordinary evening load satisfactorily and efficiently. In order that the electric current may be available without previous notice to the attendant and at any time during the day or night, which is, of course, very desirable, and in order that small amounts of electrical energy may be supplied without the necessity of operating the dynamo under a load so much less than its rated capacity as to result in very inefficient operation, it is advisable to include a storage battery in the power plant equipment.

This battery will also serve to assist the dynamo in carrying the exceptional evening loads which occur on special occasions and also as a reserve with which to tide over any temporary failure of the machinery of the plant. The capacity of the battery should be sufficient to provide for all ordinary demands except the evening lighting, for a period of several days upon a single charge. It should also have sufficient capacity so that when operated in conjunction with the dynamo the two will be capable of supplying the extraordinary demands of special occasions and of carrying the entire evening load for a period of three or four hours, at least.

As in the type of plant previously discussed the battery should discharge through a voltage regulator in order that the control of the supply of current from the battery may be entirely automatic, and the presence of the battery as a part of the equipment may be fully justified. Unlike the previous case, however, the dynamo should not be of the variable voltage type. In most cases it will be found advisable to obtain the increased voltage required for charging the battery by means of a booster set consisting of a motor and a shunt-wound, variable-voltage dynamo.

The reason for the undesirability of the main dynamo, in a plant of this description, being of the variable voltage type, is that these machines are extremely sensitive to slight changes in speed when operating at normal voltage and their compounding under varying load is not good.

Particular attention should be given to the voltage regulation of the dynamo and the speed regulation of the engine in selecting these machines for a plant of the type in question as much depends upon these features in obtaining satisfactory illumination. This is particularly important in an installation of small capacity where the throwing on or off of the lamps in some room will produce a variation in the load amounting to a considerable percentage of the capacity of the dynamo.

Such a plant as this operating under the conditions stated, if properly designed to meet these conditions, will be able to compete successfully with central station service at the prevailing rates throughout the country districts, and where the obtaining of current from a public service line involves an expenditure for underground supply wires amounting to a very considerable percentage of the first cost of a suitable plant, as is frequently the case, there is seldom any doubt of the advisability of installing the plant.

The third condition is the lighting of a large country mansion so situated that energy from the public service is available at such times as it may be needed and at reasonable rates, but not at so low a rate as to eliminate the possibility of accomplishing a saving by the operation of a private plant during the evening. This condition is not so frequently met with as the other two, but its importance is sufficient to warrant discussion here.

In order to make the most of this condition where it occurs and lay out the power plant equipment in such manner as to obtain the greatest economy of operation and therefore the lowest possible cost per lamp-hour, it is advisable to divide the electric wiring system of the building to be lighted into several portions, each supplied through separate mains running from some central point of distribution.

The question of where is the best point to bring in the public service supply mains and where the transformer, if one is required, should be located, can only be answered after a careful study of the particular local conditions, as so much depends upon the relative locations of the building to be lighted, the power plant building and the public service supply line, and also upon the nature of the grounds surrounding the various buildings.

If the public supply is brought into the power house and distributed from there, separate feed lines to each of the house mains will usually prove the most economical form of construction and the simplest arrangement. If, however, the public supply mains are brought directly to the building to be lighted, while the power plant building is separated from the main building, the safest and most satisfactory arrangement is the control of the supply of current to the house mains by means of automatic electro-magnetically operated double throw switches, operated from the power plant by master switches on the main switchboard. There should be one of these automatic switches for each house main.

This arrangement enables the power house attendant to control absolutely the output of the plant and to adjust the load carried by the dynamo and its daily period of operation, in such manner as to obtain the necessary electrical energy at a minimum cost, with the least possible interruption in the supply of current and without danger to the equipment.

The engine and dynamo should be proportioned to the average evening load. By doing this the first cost of the equipment is kept down and the economy of the plant when supplying the ordinary load is far better than could be obtained from an equipment of sufficient capacity to supply the maximum load which would necessitate the operation of the engine and dynamo on all ordinary occasions at a fractional load, not conducive to high economy in fuel consumption.

The installation of a storage battery is unnecessary, as the public supply may be drawn upon for such current as may be needed during those portions of the day and night when the load is not sufficient to warrant operating the plant, to furnish any excess of current, over the full capacity of the power plant apparatus, that may be required on special occasions or to supply the total demand in the event of a temporary shut down of the plant equipment.

For the same reason it is unnecessary to provide any spare apparatus. It is evident, therefore, that the first cost of a plant which will meet this last condition, and consequently the burden of interest and depreciation which must be added to the yearly cost of operation may be kept very low.

The installation of an electric plant being decided upon, it becomes necessary to select the prime mover which will drive the dynamo. If suitable water power is not available an engine of some kind must be provided. This immediately introduces the question as to the most suitable type or form of engine to select, from those offered for small isolated power plant service.

A consideration of the two general classes, namely: those driven by steam and those in which the fuel is burned within the engine cylinder will usually result in a choice of one of the latter type, as with the former the necessity for a high pressure boiler with its smoke stack adds considerably to the cost of the equipment and the power house building and the greater complication of the steam plant requires a greater expenditure for labor than is necessary for a plant in which the prime mover is an internal combustion engine.

In deciding upon the particular kind of internal combustion engine to install, that is, whether it shall operate on producer gas, natural gas or illuminating gas, on gasoline, kerosene or crude petroleum, a conclusion should be reached only after a careful consideration of duration of the load, the relative cost of the various fuels at the point where the plant will be located and the possible fire hazard of one or another, as well as the relative cost of the various types of engines with their auxiliary apparatus. The possibility of a disproportionate increase in the cost of any of the fuels considered or of its becoming difficult or impossible to obtain some one or more of these fuels in the future, should also be carefully considered.

After a power plant has once been installed there are many ways in which it may be used to great advantage which are, perhaps, not so fully appreciated by the skeptic in this line or

even by the prospective purchaser as they are by the owner of one of these little plants. It is a fact that the largest items of operating cost in a small plant, designed principally to take care of the evening lighting, are those of interest upon the original investment and depreciation in value of the equipment as it ages, the cost of fuel and attendants being comparatively very small items. These facts make it apparent that such energy as is used at other times than during the evening, and, therefore, without necessitating any additional investment or greater depreciation charge, may be generated at very small cost.

It is, therefore, possible to add greatly to the conveniences upon a country place equipped with an electric plant by the installation of electrically operated devices of one kind and another which would be out of the question if energy for their operation had to be purchased at the prevailing rates for public electrical supply.

Thus motors may be installed for driving pumps, churns, and farm and household machinery; electrically heated smoothing irons, curling irons and light cooking utensils may be made use of, and the storage battery of an electric launch or automobile may be charged at a very low cost.

Objection is frequently made to the presence of machinery of any kind upon a country place on account of the noise which it causes. This is very largely a question of the proper selection for the site of the power house and of the choice and arrangement of the power plant equipment. It is a matter of record that there are many small isolated plants in operation to-day which are entirely free from objection as to noise, smoke or odor.

I have endeavored to show in this discussion that the small isolated electric plant is a factor, the importance of which deserves careful consideration for it, and that if properly suited to the conditions which must be met, its presence will increase the value of a country estate and add greatly to the conveniences of country life. It is apparent, however, that the problems involved must be carefully considered and solved by one competent to deal with them. Many small plants are more of a nuisance than a convenience for the simple reason that this careful consideration was not given to the conditions beforehand, or that an error was made as to the best method of meeting those conditions.

The Small Central Station Problem.

At the annual meeting of the Kansas Gas, Water and Electric Association, Mr. Harry V. Forest, of Lyons, Kan., read a paper which treated particularly of the problems confronting the small central station. Statistics show, he said, that in the States of Kansas and Missouri out of 211 plants listed 131 are in towns of less than 3,000. So there must be some excuse for their existence, and in the aggregate they must make some money or they would not continue to be operated. It is a matter of record that very many plants do not pay any dividends while some are unable to pay operating expenses. This is not as it should be; no plant should be operated at a loss. The test of everything is results, and if a proposition cannot be made to pay dividends it has no reason for existence. The problem is how to make a country plant yield a reasonable interest on the investment after paying operating expenses, maintenance and depreciation of plant. It is remarkable how little information is available about the financial operation of plants. New men entering the business have often to go blindly, making the assumption that plants pay in similar towns so they should be able to make one pay in their own particular locality.

Three factors affect the business: The location, which cannot be changed; the equipment, which once installed cannot be changed except at considerable expense; and the management, which can be changed often enough, the difficulty being to secure the right man for the place. The first and most important factor is the location. A small town situated in an agricultural region and dependent upon farm industry for its existence is probably the most unfavorable for a lighting plant. And in comparison with it a town of moderate size, with some manufacturing industries and a wage-earning class, presents an easy proposition.

Of course the comfort and convenience of electricity appeals to every one in a greater or less degree, but if the people of a town are on the "miser" order a small increase in expense over kerosene will largely overbalance in their minds the desirability of the service. In the little towns there are so few prospective customers that the plant needs all the business in sight, and perhaps more. This means relatively higher prices, with a tendency toward less business. People in small towns have small

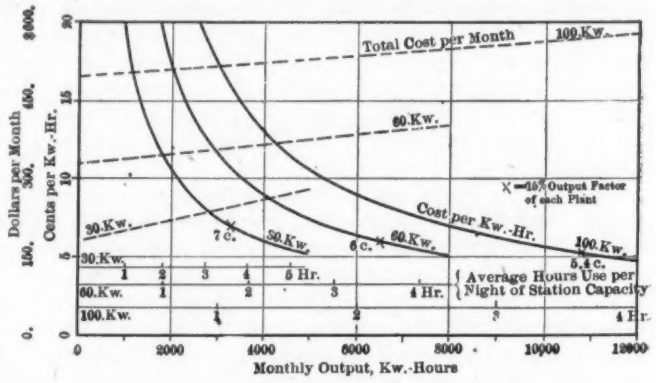


FIG. 1.—MONTHLY COST OF OPERATING DIFFERENT PLANTS.

incomes, while in the larger towns there are more people able to afford electric service, and the larger the town the larger the demand for electricity in proportion to its size.

Plants are built either from public spirit, as in the case of a municipal plant, or from desire for private gain, or mixture of both motives. But whatever the motive the plant should be built to suit the local conditions and make the greatest returns with the least allowable investment. The time to determine is before the plant is built. There should be all favorable conditions possible for the plant's success; there will be enough obstacles left.

Small plants really require the best judgment in design and construction of any. The margin of profit is smaller than in large plants, and a mistake that on a large plant would merely reduce the profit would put a small plant out of business. The plant should be simple, reliable, and fairly efficient, but the main point is to keep the investment down. For a given location a certain investment or size of plant will yield the greatest re-

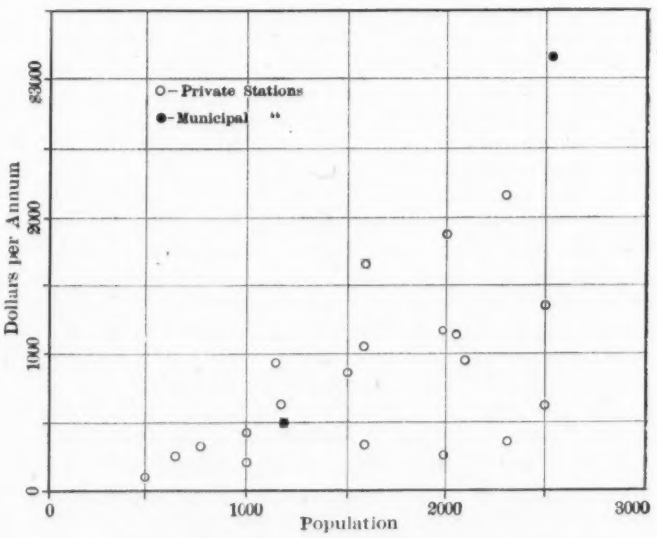


FIG. 2.—INCOME FROM STREET LIGHTING, KANSAS STATIONS.

turns; a greater or smaller investment will earn less net per cent; the loss is either in idle investment on one hand, or in lowered economy of operation on the other. It is best to start with a comparatively small station, and fairly heavy lines covering the town pretty thoroughly. Of course there is a loss due to changing equipment and rebuilding lines, but the investment and risk is reduced at the start until the business has proved itself. Moreover, the expense of operation will be less, and it will be easier to get good rates with a smaller plant. If there is a large plant for the town the investment and expenses will

be larger, and the company will need business very badly. Of course, some merchants will discover this and take advantage of it to get a low rate.

There are in the operation of a plant a number of fixed charges independent of output, and the smaller the plant the larger are these charges in proportion. These charges are largely determined by the size and design of the plant, and in a plant

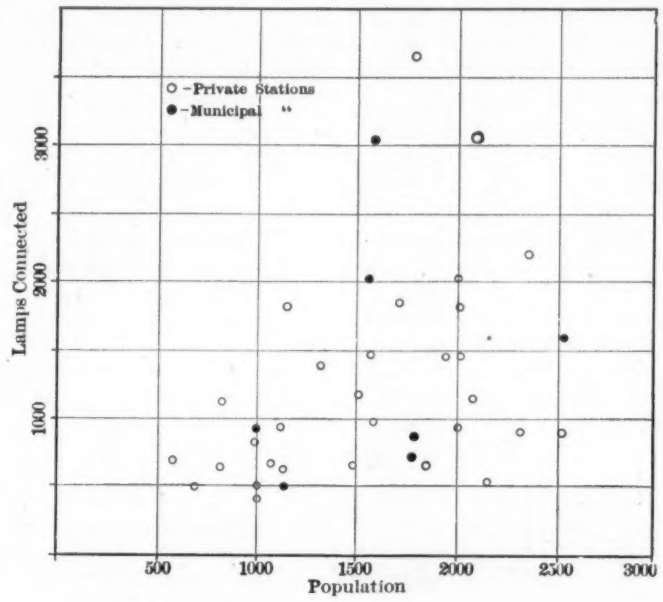


FIG. 3.—CONNECTED LOAD, KANSAS STATIONS.

once built are fixed or nearly so. The expense dependent on output is practically fixed by these same conditions, and no amount of skill in management can reduce it much below that point. The fixed charges consist of interest, depreciation, taxes and insurance, a fair figure being about 15 per cent per year. Moreover, there are operating expenses, salaries and wages, fuel, repairs and incidentals.

Once the location, size and type of a plant are determined, the operating expenses are practically fixed; the question is then one of a market for the energy, and neglecting the theories and discriminations of rate-making it is whether a certain gross

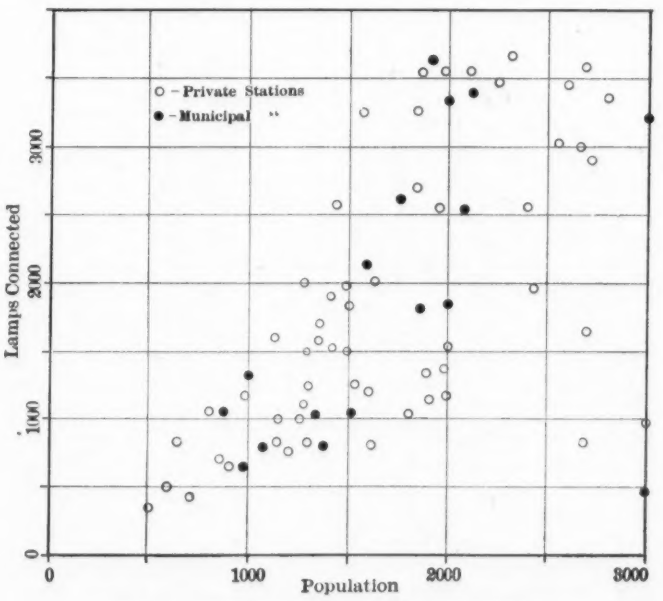


FIG. 4.—CONNECTED LOAD, IOWA STATIONS.

income for an approximate gross output can be obtained from a given locality. The problem of rate adjustment is to equalize this burden on the different consumers so the total amount can be obtained with a minimum of trouble to the company.

It is easy enough to say put in meters, no flat rates, but the business must be adapted to local conditions. And at the start in a small place and only running six hours per day the plant can make more profit on flat rates. But there will come a time when the machine is nearly loaded, and then meters can be gradually introduced, putting them in on the worst customers' first, or else cutting them off the line. This refers only to stores; residences using over four lamps should be on meter from the start.

Now the business obtainable in small towns will average about ¾ lamp per capita. Purely lighting country plants during the winter peak carry about one-half the connected load and 1 kw of station capacity will be needed for every 40 lamps connected. Figuring the average income at $2.50 per 16-cp lamp per year in a town of 1,500 population with 1,200 lamps, this would be $3,000 gross per year, or $250 per month, or $2 per capita per year. A 30-kw plant will handle this load with an output factor of 12 per cent, which means that a revenue of 8 cents per kw-hour at the switchboard at this output will pay. As a matter of fact, a well-developed plant will have an average output factor for the year of about 15 per cent. So a 30-kw plant should send out an average of 3,300 kw-hours per month and will pay if it can realize 7 cents per kw-hour at the switchboard, which it should have no trouble in doing. The retail price must be slightly higher, as line loss and slow meters will reduce the amount sold to about 70 per cent of the output at switchboard. With an 8 per cent output factor a 30-kw plant would have to realize 13½ cents at the switchboard to pay expenses.

An inspection of the accompanying diagram shows that at peak average prices the 30-kw plant must be operated at nearly full capacity, the 60-kw at about ¾ capacity, and the 100-kw at about ⅔ capacity to make any money. So the larger the plant the less of its capacity is required to pay expenses, and as the extra sales over this amount would be nearly clear profit, the larger the margin for profit and the better the plant can be expected to pay.

All these factors reach a balance and determine that as a rule 1,500 to 2,000 is the smallest population that an independent plant can serve profitably. Only a few years since the limit was much larger, and it is very probable that new applications for electricity, improvements in the art and reduction in cost of equipment may lower this limit considerably.

A plant must give good and fairly adequate service to satisfy its customers and prevent competition. If a plant is run honestly and fairly and develops its opportunities there is no excuse for competition, and if it comes the management has to that degree failed to attain the proper conduct of its business. The electric business has been singularly free from the direct competition that some companies from their own faults have a right to expect, a few isolated plants in the larger cities being usually the extent of the trouble. But the business of public service is losing its mystery and it is too much to expect the continuance of present public tolerance in this regard. If a town of 3,000 will support a plant, why will not a town of 8,000 support two, or a town of 15,000 support three? According to the "Central Station List" there is in Kansas a city of 35,000 with a light plant of 1,600 kw station capacity, 50,000 incandescents and 1,700 hp motor load. Also a city of 30,000 with a 600-kw station, other data not given. Even making allowance for error in the report it would seem that there is considerable room for growth in the latter city, if not for a competing plant.

In practice we each have a given locality to develop, and as the larger the plant the better it pays, our profits from the undertaking are in direct proportion to our enterprise and development of our territory.

There is a great deal of talk nowadays about free gifts of valuable franchises to private companies. Leaving aside the larger cities, the smaller ones merely gave away what they did not want—a privilege of no value at the time. And whatever value the franchise attained in future was the direct product of the efforts of the private company that developed the business. As to municipal ownership, the average city council cannot take the interest in the business that a private management would. Nor will there be the harmony and freedom from conflicting interests that is found in private companies, the consequence being that under city ownership they will get a kind of service at a price to the consumer sometimes a trifle lower than service from private companies. But with this commodity especially poor

service is undesirable at any price, and almost invariably the interests of the community in general will be better served by a private than a public plant.

Fig. 1 represents the cost per month of operating plants of 30 to 100 kw in graphical form. Fig. 2 represents the income of Kansas central stations from street lighting. Figs. 3 and 4 represent the connected load of Kansas and Iowa central stations, respectively.

New Telephone Patents.

IMPROVED INSTRUMENTS.

The tendency of transmitters to pack has been the source of no end of trouble, and it is even found that an instrument which will rarely pack under use will do so badly if left standing undisturbed for any length of time. This apparently occurs under the natural tendency of the granules to settle down, coupled with the effect of the minute vibrations of the transmitter as a whole with its support. Mr. H. E. Schreeve, of Newton, Mass., has found this effect particularly objectionable in repeaters, the electrodes of which in use never become subjected to any considerable motion. Because of this he has invented and patented arrangements for automatically agitating a packed transmitter. One method consists in supporting the rear electrode of the transmitter upon an auxiliary mica diaphragm exactly as for the front one. For the bridge is then substituted a thermostatic arch surrounded by a heating coil included in the transmitter circuit. Any packing is accompanied by excessive current which disturbs the equilibrium of the arch and causes a pull upon the back electrode. This is followed by a push as the arch cools off under the diminished current. The result is an effective agitation of the granules.

The same result can be accomplished magnetically by rendering the electrode support magnetic and by including a suitably placed electromagnet in the circuit. In this case considerable impedance must be included in this circuit to prevent any disturbance of the electrode due to leakage of voice currents through the coil. On the other hand, a condenser must shunt the regulating circuit to provide a path for these currents. Mr. Shreeve has assigned both his patents to the American Telephone & Telegraph Company.

Mr. J. McMahon, of Oakdale, Cal., has patented a receiver having contained within it the hook switch elements. The springs are disposed within the U magnet and are operated by a

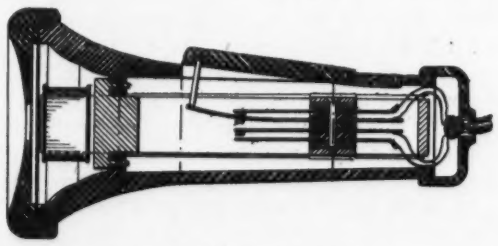


FIG. 1.—M'MAHON RECEIVER.

hinged bar under control of the grip of the user. This is shown in Fig. 1. The five-strand receiver cord is, of course, a considerable point against this arrangement.

A head telephone set forms the subject of a patent granted to J. Pieringer, of Jersey City, and assigned to the Western Electric Company. The set comprises a head harness considerably more elaborate than the usual head band. This carries a receiver for one ear, and a transmitter casing at the other ear. An adjustable mouthpiece extends into proper position. This arrangement produces a set, the parts of which nicely balance and one of which shields both ears from extraneous noise.

A hand microphone, especially designed to avoid singing, has been invented by A. A. Lind, of Malmo, Sweden. The receiver and microphone parts are in one case, the hollow handle serving as a mouthpiece. The microphone has a double diaphragm, one plane and one with a shallow dish-shaped recess. The diaphragms are placed so near each other that while they are free to vibrate independently, the large granules in the recess cannot escape. The sound waves are delivered against both diaphragms so that they vibrate oppositely. Vibration from the receiver is of little effect, however, as it affects the diaphragms synchronously.

It has been long known that a double-wound receiver will talk with one end of each winding open. The more intimately the two windings are associated the better the efficiency. Mr. C. M. Jacobs, of Reading, England, finds that the use of such a receiver, wound bifilar, greatly reduces the effect of induced disturbing currents. He finds the effect more marked if an impedance be shunted about the receiver. He has covered both arrangements by a patent.

W. M. Davis, of Seattle, Wash., has patented the system shown in Fig. 2. This is almost self-explanatory and against

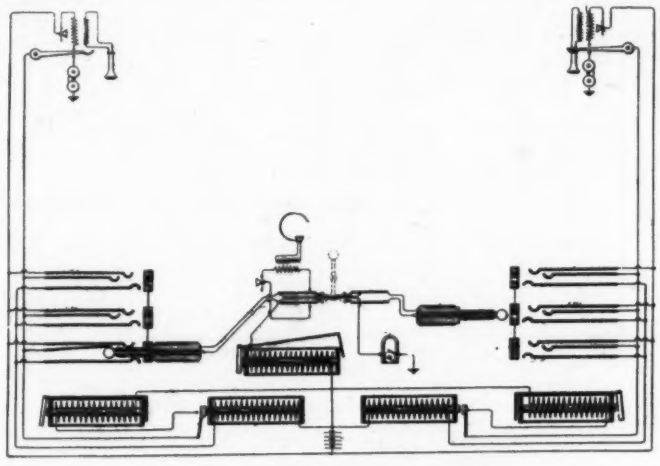


FIG. 2.—DAVIS TELEPHONE SYSTEM.

its merit, simplicity, must be scored the negative supervisory signal.

MANUAL SYSTEMS.

F. B. Parker, of Lafayette, Ind., has patented a circuit system for central-signalling, local-battery talking. The same signal lamp serves for calling and supervision. The key to the system is the line jack, which has auxiliary springs so connected that the signal lamp with its grounded battery is switched from one

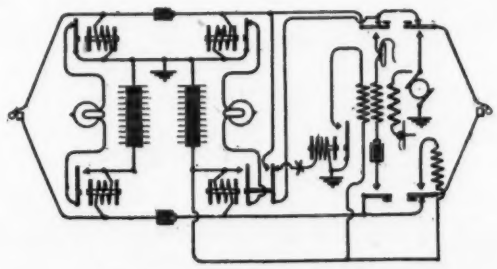


FIG. 3.—DEAN TESTING SYSTEM.

limb of the line to the other on the insertion of the plug. Normally one limb of the line is grounded at the jack while the other has the signal and battery connected to it. The rising of the hook closes the circuit to display the signal. The plugging-in cuts off the ground at the jack, and connects the signal to this side of the line. Now the signal is out until a ground is introduced at the station by the return of the hook against its grounded back stop. Fig. 3 shows the arrangement of listening key found necessary by W. W. Dean in order to have a satisfactory busy test with a two-wire multiple system. As the test ring of the jacks is in the talking circuit, an infinitesimal current only must escape in testing if a conversation is not to be disturbed by the testing of operators. Because of this the test relay is of high resistance. However, unless the supervisory relay were cut off by the listening key its low resistance would defeat the end sought. It is here that the invention lies. Mr. Dean has assigned his patent to the Kellogg Switchboard and Supply

Company. Another patent assigned to the same company has been issued to A. D. T. Sibby, describing a circuit system adapted for use with magneto instruments but readily convertible to common-battery. The line relay is sensitive to alternating currents and when once operated it locks, maintaining the line signal until released by the response of the operator. Similarly, the cord signals are controlled by a locking bridged relay, sensitive to alternating currents, the lock being controlled by the listening key and the plugs.

SEMI-AUTOMATIC SYSTEM.

A rather simple idea forms the basis of an interesting semi-automatic switchboard system patented by A. T. M. Thomson, of London, England. The whole system hinges on the arrangement of the subscriber's sender so that it will repeat its setting several times at will. By this arrangement, upon the response of an operator to a line signal, by connecting a pair of cords, the desired number comes in upon her register. From the information she plugs ahead in the right direction just as though the subscriber had spoken. The answering of the signal thus placed before the next required operator, registers the call at her position and she may advance the call again and so on until the connection is completed. There seems to be good possibilities along this line. Mr. Thomson has worked out his system in considerable detail, but this represents but one of many practical adaptations of the fundamental principle.

APPARATUS IMPROVEMENTS.

In Fig. 4 is shown an improved switchboard plug with a split shank with a nut at its base. This provides a shank in which not only may a cord be inserted easily but also an effective clamp to

FIG. 4.—DOZIER PLUG.

hold the plug tightly on the cord. A. B. Dozier, of Taylor, Texas, is the patentee.

Marcus Frank, of Cincinnati, advances the theory that a soft pad of feathers between a receiver and the ear of a user improves the transmission. He terms such a pad with an apron for holding it to the receiver, a "Sound Sensitizer," and he has covered it by a patent.

A combined receiver, induction coil and calling signal forms the subject of a patent granted to D. H. Wilson, of Chicago. The induction coil is wound on a U-case which carries the receiver cases and coils. A sound tube leads from the diaphragm chamber to the ear. A vibrator before one pole of the coil serves as a call, its contacts being included in circuit during calling.

A hook switchboard control has been patented by J. Silverman, of San Francisco. This comprises an arm under the continued action of a spring so that it has no stable joints except its stops. One stop is the hook switch lever, which becomes depressed under the pressure; a slight touch and the lever flies against its other stop, releasing the hook.

LETTERS TO THE EDITORS.

Racial Engineering.

To the Editors of Electrical World:

SIRS:—I venture the opinion that Mr. Henshaw did not go very deep into the question before writing down his letter on "Racial Engineering" in your issue of December 8.

Referring, for instance, to the American Institute of Electrical Engineers, the Engineers' Society of Western Pennsylvania, the Electric Club (Westinghouse employes) and the American Society of Swedish Engineers, we have examples of different attempts to bring together engineers with special interests in common. They are all trying to give their members a broader view of the wonderful technical progress of our great country and the reason for the existence of each society depends simply upon this function.

I refuse to believe that the organization criticized can make only for race separation as Mr. Henshaw further asserts. We are trying to assist our members in acquiring American ideas and the "Yankee push" and I have found our average member become more rapidly Americanized than those who are non-members. In regard to the question of obtaining for the American Society of Swedish Engineers executive room in the Engineers' Societies Building. I do not know to what extent the building can allow space for lesser organizations, but if there be room to spare I believe it would be to some advantage to the great undertaking to get our engineers interested in the Engineers' Home from their very start in this country.

I believe few countries have furnished and are furnishing the United States with a greater number of educated engineers than Sweden, and we like to think that the Swedish-American factor is not the least efficient in our great system for transmuting raw material and brains into the different necessities of modern life. We are proud of being Americans, but not in the least ashamed of being Swedes.

SWISSVALE, PA. FILIP FREDEN.

Segregation of Foreign Engineering Societies.

To the Editors of Electrical World:

SIRS:—Mr. F. V. Henshaw's letter in ELECTRICAL WORLD of December 8 is certainly a good argument against "A Scandinavian Engineers' Union," for which I tender him my sincere thanks. It does not, however, apply to the "American Society of Swedish Engineers" for the reason that this society is organized chiefly for the purpose of helping newcomers to this country to understand "the American spirit," and to get their "first job." Papers are read, discussions held and social gatherings formed mainly to keep the elder members' interest alive, and it is deeply to be regretted that the "American spirit" altogether too often takes such hold of the Swedish American engineer that he, for the sake of his new friends, forgets the helping hand, that he almost invariably so eagerly sought and accepted upon arrival to this country. However great opportunities this country may offer, as a matter of fact it must be admitted that said helping hand is almost indispensable to the newcomer if he wishes to be admitted to his profession over here within a reasonable time. Perhaps Mr. Henshaw, never having entered this country as a foreigner, is unable to appreciate this very substantial "raison d'être" which is so widely different from the motive of an American engineering body.

It may also be stated right here that there is probably no foreigner who will more readily assimilate himself with this great republic than the Swedish engineer, who will also be found to use his first opportunity to join one of the American engineering societies.

In conclusion I would say that should the Swedish-American engineers entertain and through their organization uphold a certain well-founded pride in having graduated at Stockholm, Sweden, so much the better for them, and to ask them to tear all ties between themselves and their college, or to ask Mr. Henshaw not to feel himself under a special obligation to his own college, is to ask for an almost inhuman ingratitude of which I hope not even a Swedish-born American citizen would be guilty.

MILWAUKEE, WIS. J. E. FRIES.

Aluminum and Copper Transmission Lines.

To the Editors of Electrical World:

SIRS:—It is interesting to note the comparative behavior of copper and aluminum transmission lines under abnormal conditions. About the middle of last November a heavy blow came up one afternoon and continued late into the night. One of these lines, the aluminum, was out of business almost as soon as the storm struck it and was not cut in till the afternoon of the next day. This transmission line is three-phase, 30-cycle, 19,000-volt, having two circuits on the poles and using glass insulators of the triple-petticoat type. The conductors consist

of six strands of No. 10 wire. In ten miles of this line, which runs at right angles to the direction the storm took, not less than a dozen breaks were counted. All of the breaks were between the poles, and not being due to guys giving way or pins breaking, were evidently caused by wind pressure directly on the wire.

The copper line is a three-wire, three-phase line and had two breaks, one of which was caused by a falling tree. The only other break was due to a broken insulator, which are all of porcelain.

The two lines are in adjacent counties, thus working under the same weather conditions. They are of nearly the same length and operate at the same voltage and frequency, the aluminum line, however, transmitting about double the amount of power of the copper line. The copper is No. 2 solid. No snow, hail, sleet or rain fell during the storm.

Zeeland, Mich. J. Edw. Kamps.

Price of Tantalum Lamps.

To the Editors of Electrical World:

Sirs:—Referring to a letter in your issue of December 15 by E. G. Kennard, of London, England, on the price of tantalum lamps as made by American manufacturers in comparison with prices charged for the same lamps abroad, I would state that early last fall the price of the American tantalum lamp was reduced to 60 cents list. With a discount of 20 per cent to central stations on annual contracts this brings the price below 50 cents. America, therefore, still keeps below the English prices on these lamps.

Harrison, N. J. F. W. Willcox.

[The New York Edison Company supplies tantalum lamps to residence and other minor customers at 35 cents each, in lieu of free renewals of carbon filament lamps.—Eds.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Alternators.—Lincoln.—A continuation of his long illustrated serial on the performance and operation of alternating-current generators. The author discusses power factor and rating, automatic regulation by means of composite windings or automatic regulators, and efficiencies. In discussing the operation of alternators he deals especially with methods of synchronizing and engine requirements for operation in parallel.—*Elec. Jour.*, December.

Direct-Current Machines.—Menges.—A long letter dealing with the mathematical theory of compensation and commutation of direct-current machines. The writer claims that the modern commutation theories are not exact.—*Elek. Zeit.*, November 29.

Pressing on Armatures.—Sinclair.—A note giving practical rules for pressing armatures on engine shafts.—*Elec. Jour.*, December.

Power.

Cost of Energy.—Hutton.—In the introduction of a paper on the production of iron and steel in the electric furnace, the author gives some figures on the cost of energy. The cost of energy from waterfalls varies from about $20 per electric horse-power-year at Niagara Falls to something like $4 in some Norwegian hydraulic plants. The question of power generating in a steam plant on a large scale, for continuous use at full load and on the spot, without the cost of a distributing system, is entirely different from the ordinary conditions of electric central stations. In a power plant properly designed for the purpose and with a small number of large units, the author believes that in favorable situations, with cheap coal and with good water supply the kw-hour can be obtained by steam at the total cost of about 0.5 cent. "There are in England several large private plants running under these conditions, and so far as can be gathered from the evidence (see e. g. Minutes of Evidence of Royal Commission on Coal Supplies) the actual cost in practice is not materially above this figure." Concerning the cost of energy from gas it is stated on authority of the Power Gas Corporation that "in the case of a Mond ammonia recovery gas plant working continuously with a heavy load, with coal at $2 per ton (the gas being used for power and heating purposes), the total cost of electricity (excluding interest and depreciation) produced by means of six 300-hp gas dynamos, amounted to only 0.2 cent per kw-hour. The same company, as a result of its extensive experience, is able to estimate the cost with a 3,000-kw plant, working 132 hours per week, and with coal at $2 per ton, at 0.1262 cent per kw-hour total working costs, or 0.210 cent per kw-hour, inclusive of interest and depreciation charges."—Lond. *Engineering*, December 7.

Water Power in South Africa.—Several articles and notes on the scheme of transmitting energy from the Victoria Falls of the Zambesi to the Rand. The line will be over 600 miles in length, probably of aluminum, suitable for transmitting 30,000 hp and carried on steel towers 60 ft. in height. It is proposed to use three-phase transmission at a pressure of 150,000 volts and a frequency of 12½ periods, with the conductors spaced at the angles of a 14-ft. equilateral triangle. But all this is still subject to modification and there might even yet be transmission on the Thury direct-current series system. It appears that the original plant is to be furnished by the Allgem. Elek. Ges. in Berlin, and that German capitalists are interested in the scheme. There is a long letter by Hammond criticising the whole scheme for engineering reasons and claiming that a steam plant near Johannesburg could deliver energy at a much lower cost than that at which it could be transmitted from the Zambesi, and with a much greater assurance of continuity of supply.—Lond. *Elec. Rev. and Elec.*, December 7.

French Power Plants.—Montpellier.—Statistical data at electrical stations in the Cote-d'Or district with a map of the district. There are 17 generating stations, supplying current to 35 towns. Of these 17 stations, 12 have only local networks, while the five others supply current to a number of towns. Thirteen of the 17 stations utilize water power. The stations produce direct-current, three single-phase current, three three-phase current and one both single-phase and three-phase current. All of the five stations having transmission lines generate alternating current.—*L'Electricien*, December 8.

A Scotch Water Power Station.—A fully-illustrated description of the Snowdon water power plant of the North Wales Power & Traction Company. The power is used mostly in quarries in the neighborhood, but will also be employed for traction and lighting. At present the power house contains 40 alternators generating three-phase currents at 10,000 volts and 50 cycles. The capacity of each alternator is 1,500 kilovolt-amp. —Lond. *Elec. Rev.*, December 7.

Producer Gas.—Schoettler.—The first part of a long paper read before the Berlin Electrical Society on producer gas, different types of gas producers and gas engines.—Elek. *Zeit.*, November 29.

Irrigation in Hawaii.—O'Shaughnessy.—The first part of an illustrated article on modern irrigation in the Hawaiian Islands. The present water supply of the islands is derived from two sources. First by gravity from the natural flowing streams, the impounding of the flood waters of these streams and by the interception of ground water by tunneling. Second by pumping ground water or artesian waters from wells and sumps, excavated near the seashore. The pumps are driven either with coal or oil as fuel, or by electricity generated from water power.—*Jour. of Elec. Power and Gas*, November 24.

Traction.

Regenerative Control of Tramcars.—Raworth.—A paper before the British Inst. Elec. Eng. on his regenerative system of electric traction. He states that actual experience has shown that even on level lines regeneration produces a saving in energy of over 10 per cent and wherever the country is undulating from 20 to 30 per cent may be expected. The design of a series-

parallel controller offers distinct difficulties in this case. The difficulty of changing from series to parallel or vice versa with shunt-wound motors, consists principally in the fact that the speed of the armature varies inversely as the strength of the field and directly as the voltage across the brushes. It is obvious, therefore, that in changing from series to parallel the field strength must be practically doubled, otherwise the moment the armature circuit is closed across 500 volts a violent attempt will be made by the motors to accelerate the car. The operation of strengthening the field can be carried out fairly quickly, but not quickly enough; consequently it is necessary to insert some resistance in series with the armature to check momentarily the rush of current due to the inexactitude of the field strength. It is also necessary to insert some series field winding in series with each armature, for without this precaution the motors would not work in parallel. It is also an essential condition that in breaking the current either when going out of series or when coming out of parallel, there shall be no resistance in circuit, otherwise there will be heavy flashes in the controller. In this respect shunt motors differ entirely from series motors, in combination with which latter resistance are necessary when opening the circuit. The whole scheme of the operation of the controller as now used is shown in Fig. 1. Referring to this

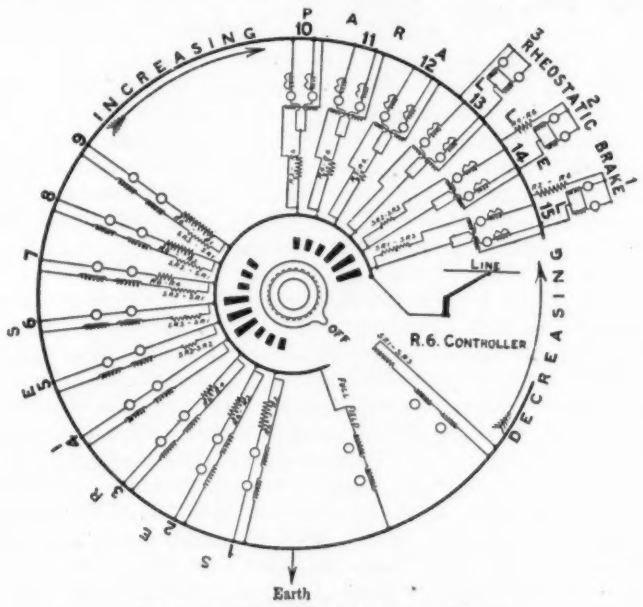


FIG. 1.—REGENERATIVE CONTROL OF CARS.

diagram, it will be seen that the shunt field circuit is first closed; then on the first notch the armatures are connected in series with resistance. The resistance is then cut out in steps, and notch No. 4 the armatures are in series across the full voltage, the fields being fully excited. This notch gives a speed of from 3½ to 6 miles an hour, according to the type of motor used. It is an advantage to have the minimum speed as low as possible, both for the sake of economy in electricity, due to the reduction of the rheostatic period and because it is the minimum speed at which motors will return energy to the line. On notches 5 and 6 resistance is inserted in the shunt field circuit with the object of increasing the speed, the speed on the sixth notch being 3 to 4 miles an hour faster than the minimum speed. On notches 7, 8 and 9, when the controller handle is being turned in a clockwise direction, the connections are exactly the same as on notch 6. Thus, when the circuit is opened preparatory to going into parallel, there is no resistance in the armature circuit. On notch 10 all the resistance in series with the shunt field coils is cut out, thus giving the maximum field strength, the armatures are connected in parallel, each in series with its series field winding, and resistance is inserted in the main circuit. A resistance is put in parallel with the series windings in order to shunt a portion of the current; only so much current as will balance the load between the two armatures is allowed to pass through the series windings. On notches 11 and 12 the resistance in the main circuit is cut out in steps, and on notch 13 the armatures are in parallel across the full voltage, the field strength being at the maximum. On notches 14 and 15 resistance is inserted in steps in the shunt field circuit to attain the top speeds. Some results of actual tests with the system are given.—Lond. *Elec. Rev.*, December 7.

Regenerative System.—JOHNSON.—An abstract of a paper read before the Manchester Association of Engineers on the Johnson-Lundell-Lang system. A fundamental aim was to relegate shunt excitation to the single duty of regenerating, in which duty alone it is indispensable and at all other times to operate the motors under series excitation simply. In realizing this aim it has been found practicable to retain in a regenerative system the inherent advantages of the standard series traction motor, and to avoid the losses and incidental disadvantages of shunt excitation. According to preliminary tests made on the Norwich tramways, the regenerative car on the Johnson-Lundell system effected a saving in energy used per car-mile of about 30 per cent on the average; the saving depended on the direction of running the car.—Lond. *Elec. Review*, December 7.

London Subway.—The first part of an illustrated article on the Great Northern, Piccadilly & Brompton Railway, which is the most important part of the group of tube railways in London. The greater part is in twin iron-tube tunnels. The current is supplied from converter sub-stations. For ventilation 19 exhaust fans have been installed, mostly in the station buildings, each capable of drawing out 18,500 cu. ft. of air per minute. The controlling devices of the trains are arranged according to the standard Sprague-Thomson-Houston multiple-unit system.—Lond. *Elec.*, December 7.

Electric Locomotive.—An illustrated account of tests of the Ward Leonard-Oerlikon electric locomotive, which has been in use for over two years at a trolley potential of 15,000 volts. Characteristic curves and a diagram of motor connections are given.—*St. R'y Jour.*, December 8.

Testing.—BEACH.—In a continuation of his illustrated serial on tests of large motors, generators and motor-generator sets, he deals with the testing of railway car and locomotive equipments, and shows how tests closely fitting the conditions of real railway practice may be carried out in the testing laboratory. He deals especially with what is known as the fly-wheel test.—*Elec. Jour.*, December.

Train Tests.—ASHE.—A description of a series of tests recently carried out by the author on the elevated system of the Brooklyn Rapid Transit Company. He then gives the speed-time curves derived from these tests, and discusses the various records which have been secured in tests of this kind.—*St. R'y Jour.*, December 1.

Wires, Wiring and Conduits.

Temperature Coefficient of Gutta-Percha.—WINNERTZ.—In the manufacture of gutta-percha cables, observations have recently been made which should be taken into consideration to avoid mistakes in calculating the insulation resistance. It has been found that the shape of the curve of the temperature coefficient of gutta-percha is different from what it had been assumed to be before, especially at low temperatures. This fact was first found in cables which were used near the freezing point when the values of the insulation resistance calculated by means of the heretofore usual temperature coefficient for the standard temperature of 75° F., were found to be too low. It was established that the coefficients are not the same at all temperatures as had formerly been assumed. The author shows how to avoid such mistakes.—*Elek. Zeit.*, November 29.

Electro-Physics and Magnetism.

Electric Resistance of Alloys.—WILLOWS.—Rayleigh has formerly proposed a theory on the electric resistance of alloys, based on the thermo-electric properties of a mixture of metals. When electricity flows from one metal to another there is an absorption or development of heat at the junction—the Peltier effect. The temperature disturbance thus created increases until the conduction of heat through the metals balances the Peltier effect at the junctions, and it sets up a back e.m.f. The difference of temperature at the alternate junctions is proportional to the current, so is also the back e.m.f. called into play. But a reverse e.m.f. proportional to current is indistinguishable experimentally from a resistance, so that an alloy should, on these grounds, possess a spurious resistance, differing in nature from

that of a pure metal. It would be interesting to separate the true and false resistances. Liebenow has attacked this problem indirectly while the present author endeavored to prove the existence of false resistance directly. His method is based on the following argument. Suppose a current runs through an alloy and that it sets up a back e.m.f.; if it is now quickly reversed this inverse e.m.f. will at first assist its passage and more will flow in the second direction than in the first, or, what comes to the same thing, the resistance will appear to be less for the quickly reversed current than for the steady direct one. As the temperature of the junctions will be equalized rapidly on account of their small distance apart, the current reversals must be rapid. The author, therefore, used an alternating current. However, the results of his experiments were negative.—*Phil. Mag.*, December.

Real and Magnetizing Power.—Boucherot.—A mathematical note on the separation of real and the magnetizing power in alternating-current calculations, and on the advantages of this method for various purposes.—*La Revue Elec.*, November 30.

Electro-Chemistry and Batteries.

Electric Furnace for Iron and Steel.—Hutton.—A paper read before the Sheffield Society of Engineers and Metallurgists. In the introduction he gives numerical data on the cost of generating energy. (See abstract above under "Power.") Concerning the future of the electrical furnace, the author makes the following remarks: The difficulties in achieving an economical utilization of fuel as the higher limits of temperature are approached and, on the other hand, the necessity in many ordinary metallurgical processes of transferring the heat from the burning fuel through the walls of a crucible, retort or other containing vessel, are two factors which are bound to tell in favor of the adoption of electric heating, as the availability and decrease in cost of development of electric power progress. But in certain cases it is not improbable that the electric furnace, while striving to annex some branch of metallurgical work, may itself be ousted by causing the improvement of the fuel-heated furnace it is trying to displace. The author then speaks of the manufacture of the ferro-alloys in the electric furnace, especially of those richer alloys free from carbon. He then reviews the possibilities of reduction of iron ore in the electric furnace, chiefly on the basis of the results obtained in the recent experiments at Sault Ste. Marie. The main part of the paper deals with the production of high-grade steels, the induction furnace of Kjellin and the furnaces of Héroult, Keller, Girod and Stassano being described.—Lond. *Engineering*, December 7.

Units, Measurements and Instruments.

An Alternating-Current Wave Form Device.—Brackett.—To determine the form of the e.m.f. wave of an alternator by the ballistic galvanometer method, requires both an accurate angular setting of the armature and its exact rotation through very small angles. This is equally true whether the effect on the galvanometer is produced by reversing the field of the alternator or by quickly rotating its armature through a small but definitely limited arc. For each method a double or duplicate Prony brake, as shown in Fig. 2, is remarkably satisfactory. Two similar clamp

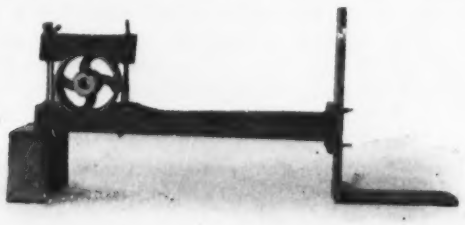


FIG. 2.—DOUBLE PRONY BRAKE.

brakes with long arms are placed on the pulley side by side. With the arms held rigidly the desired readings for one observation are made. Then brake 1 is unclamped at the pulley, the end of its arm released and rotated up a short distance to a fixed stop. Brake 1 is now clamped to the pulley, brake 2 is unclamped and the end of 1 turned down to its original position, rotating the armature with it. Then 2 is clamped again. Thus the armature has been rotated through a small angle that may be computed with great accuracy from the length of the arms and the distance through which the end of arm of brake 1 is moved. When very small angular changes are desired the arms should be quite long. If it is desired to read the angles directly, an arc equal to the maximum value of any one movement is all that is required to be graduated. Thus all the advantages of a graduated circle with a radius of six feet or more may be secured. The somewhat crude form of this apparatus shown in the illustration has been used to trace e.m.f. waves in which the effects of the armature teeth are plainly visible.—*Clarkson Bulletin*, Vol. 3, No. 4, October.

Potentiometer.—Taylor.—In a continuation of his illustrated serial on the standardizing laboratory, the author describes a special potentiometer, the special features of which consist in an arrangement of connections which make it convenient for use in measuring resistances as well as voltage and current, and in the unusual high insulation between parts.—*Elec. Jour.*, December.

Telegraphy, Telephony and Signals.

Protective Device Against Accidental Sparking in Wireless Tele-Mechanisms.—Branly.—Accidental sparking may be rendered harmless in two ways, either by a rigorous syntonization, which insures that the sensitive receiving system does not respond to a fortuitous wave length or by an opportune breaking of the working circuit, which insures that the conductivity of the coherer does not bring about the operation. The author utilizes the second method, operating by a break in the working circuit, for a new method of preservation. When an accidental spark has acted upon the coherer circuit and the relay has been brought into play, the working circuit is kept open by a special interrupter, which forms the essential feature of the protective device.—Lond. *Elec.*, December 7.

Wireless Telegraphy.—Burstyn.—The lower end of the air wire in wireless telegraphy stations is either connected with earth by means of an earth plate or it is insulated, and is provided in this case with a so-called "counterweight"; that is, an insulated network of wires suspended above ground. It had been thought that in the latter case energy losses in the earth are avoided. But the present author shows mathematically that the counterweight of the air wire damps its oscillations, on account of ohmic losses in the upper layer of the earth. This detrimental damping effect, which may attain a considerable value, is approximately calculated by the author with the aid of vector diagrams.—*Elek. Zeit.*, November 29.

Wireless Telegraphy.—Meyer.—A full reprint, with annotations, of the recent international agreement on wireless telegraphy.—*Elek. Zeit.*, December 6.

Directed Wireless Telegraphy.—Fleming.—A paper giving the mathematical theory of the electric radiations proceeding from bent antennas, and its application to Marconi's method of sending wireless messages in a certain direction.—*Phil. Mag.*, December.

Miscellaneous.

Lifting Magnets.—Eastwood.—A fully illustrated article in which the author first gives an outline of the design of lifting magnets as developed by Wellman and Clark. Other designs especially adapted for handling detached material such as scrap, pig iron, etc., are also dealt with, and a great many different applications of lifting magnets are described and illustrated.—*Cassier's Mag.*, December.

Annalen der Elektrotechnik.—This is a new German monthly which first appeared during the year 1906, and contains abstracts of papers and articles relating to all fields of electrical engineering. It is edited by F. Hoppe. In its arrangement it is somewhat similar to the English Science Abstracts, though its contents are restricted to electrical engineering. The first part of each issue contains the long abstracts; the second part contains the brief references.

Iron.—Hadfield.—Some remarks made by him at the recent dinner of the British Inst. of Elec. Eng. He spoke of "the directions in which the metallurgist had helped his electrical colleagues, especially in the case of the metal iron, during the last ten or twelve years. He could now give them an 'iron' which was non-magnetic, an 'iron' with less hysteresis than pure iron,

or an 'iron' with twelve times the resistance of the ordinary iron."—Lond. *Elec.*, December 7.

BOOK REVIEWS.

POOR'S MANUAL OF RAILROADS. Thirty-ninth Annual Edition, 1906. Poor's Railroad Manual Company, New York, 800 pages, 83 maps. Price, $10.

This invaluable publication is as welcome as ever to the financier, engineer and economist. In this edition the following important features, heretofore published separately in "The Railroad Manual Appendix," have been incorporated, viz.: 1. All data embraced in "Poor's Ready Reference Bond List. 2. Table of Annual Meetings, Transfer Agencies, etc. 3. Table of Dividends paid for eight years. Although the addition of these departments to the Manual has largely increased the scope, size and cost of the book, the subscription price remains unchanged. By the addition of the new features above referred to and the natural expansion of the regular departments of the book, the work this year has increased in text 192 pages, statements for no less than 120 new industrial corporations having been procured and incorporated in this new issue. The sections devoted to electric railway data are very full and complete.

THE COPPER HANDBOOK. Volume VI, 1906. By Horace J. Stevens, Houghton, Mich. 1,100 pages. Price, $5.

The well-known Copper Handbook, by Horace J. Stevens, has now reached its sixth volume. It lists some 5,000 copper mining companies in all parts of the world. In addition to the information regarding copper properties, there is a valuable compilation of copper statistics as well as useful information regarding the history, geology, mineralogy and metallurgy of copper.

The book contains much solid information of a sort valuable for mining men and practical miners, including a complete list of the copper minerals, with their various names and characteristics, a summary of copper geology, chemistry and methods of treatment, including milling, leaching, smelting, etc. The detailed descriptions of the various copper mines of the world give a mass of facts, all prepared in logical order, that cannot but prove of vast benefit to any practical man who reads the work, as they furnish a bird's-eye view of the copper mining, milling and smelting industry of all countries and all ages, with developments down to date. The importance of copper in all the electrical industries makes this a valuable volume for many electrical manufacturers and electrical engineers.

APPLIED ELECTRICITY. A text-book for second-year students. By J. Paley Gorke. London: Longmans, Green & Co. 420 pages, 153 illustrations.

In his preface the author states that this volume is intended as a text-book in electrical engineering, for students who have already become acquainted with the elementary fundamental principles and laws of magnetism, and who have also a knowledge of the elements of mechanics, heat and mathematics. It might more specifically be termed an elementary introduction to electrical engineering, and as such should be useful to students prior to their taking up special books dealing with the various branches of electrical engineering. As the whole range of applied electricity is treated, the space devoted to each field of application is necessarily limited. Fortunately, the brevity of treatment is partly compensated for by the use of numerical examples illustrating the application of the principles established.

BERLIN-ZOSSEN ELECTRIC RAILWAY TESTS. Translated by Franz Welz. New York: McGraw Publishing Company. 58 pages, 18 illustrations, 38 plates. Price $3.00.

This report is of great practical value to all interested in electric traction. It is also of great interest to the student of electrical engineering, mechanical engineering, locomotion or sociology. The translation is excellent, and has the advantage of retaining the original quantities as stated in the metric system; or in foreign money, together with the corresponding American equivalent in parentheses.

The achievements on the Berlin-Zossen railroad constituted an epoch in the history of electric railroad development and created a distinct advance in the traction art.

The value of the volume has been enhanced by a good introduction from the pen of Dr. Bell, addressing the results to the American reader.

The report is one which no good technological library can dispense with, either in the original language or in this very convenient translation.

INDUSTRIAL FURNACES. By Prof. Emilio Damour. Ingenieur Civil des Mines. Authorized translation with additions by A. L. J. Queneau, B. S. (Paris), E. M., A. M. (Columbia). New York. The Engineering and Mining Journal. 317 pages, 88 illustrations. Price, $4.00.

In view of the great interest manifested in the production and use of gas for various industrial purposes this book will be a welcome addition to the literature on this subject, by those who wish to thoroughly master it from a theoretical as well as a practical standpoint.

Part I deals with the experimental determination of the efficiencies of these furnaces. Part II treats of the methods of control, pyrometry and gas analysis, also of calorimetry and elementary fuel analysis. Part III gives design of furnaces for powdered fuel, chimneys, regenerators, recuperators, reversing valves, ports and hearths.

The author states that gas furnaces are more economical by 30 per cent than those operated by direct hand firing, therefore he wonders why the latter are still used, but concludes that this great waste is at least partly due to the fact that it requires intelligent and educated men to operate the gas-fired furnaces, and these are not always available for this class of work. This should prove an incentive to young men who are naturally interested in such matters to become qualified for desirable positions along this line, and a careful study of this volume will prove of great benefit to those who are not easily discouraged. The illustrations give very clear ideas of the design and construction of numerous furnaces that are efficient under stated conditions, and the theory of their operation is given in a very thorough and satisfactory manner.

PRACTICAL ALTERNATING CURRENTS AND POWER TRANSMISSION. By Newton Harrison. New York: W. L. Hedenberg Publishing Company. 375 pages, 172 illustrations. Price, $2.50.

This work is of the well-known type of the "practical book for the practical man." As such it displays the usual lack of perspective and systematic treatment, the obvious is dwelt upon and the difficult involved in delphic utterances. The following examples, selected at random, will illustrate the character of the work: After an academic classification of sources of power, the only two treated specifically with illustrations are sea-wave motors and the Ericsson solar engine. Alternating-current distribution is defined as "a system composed of a series of separate parts at the points of metallic separation, while associated only inductively." In discussing central station location the reader is informed that the lines are not laid carelessly or purposely, but are placed in certain locations with regard to the central source of energy. In treating of self-induction it is stated that "although the e.m.f. of the current passing into the circuit is operating on the said circuit, it cannot instantaneously cause a current to flow"—the author thus apparently being ignorant of the fundamental principles of alternating-current flow. A gem is the definition of resonance: "By resonance in circuits is meant a condition in virtue of which neither the capacity or inductive reactance is individually operative. While both are present, yet neither appears except as a cause for a higher electromotive force." Such examples might be reproduced indefinitely, and indicate that the author instead of attempting to expound the scientific principles of electricity, sadly needs instruction in them himself. Perhaps an intuitive recognition of this failing led to the following prefatory defiance to critics: "A non-producing class exists, whose main work consists in the assumption of

superior attitudes toward the earnest efforts of others, particularly when crystallized in book form."

In favor of the book it may be said that the illustrations are superior to those found in most books of its character, and that many of the diagrams of circuits will be found useful by electrical workers.

The Energy Chart. By Capt. H. Riall Sankey. Rugby: Albert Frost & Sons. 170 pages, 157 illustrations.

For assisting the mind in grasping the significance of the various processes involved in thermodynamic computations connected with the operation of reciprocating steam engines, several methods have been devised for representing the values graphically. Owing, however, to the numerous inter-relations of temperature, pressure, volume, weight and energy, some of the methods of representation have been quite complicated. One of the simplest graphical diagrams is the pressure-volume chart, an illustration of which is found in the engine indicator card. An equally simple diagram, but one not so well known, is the temperature-entropy chart.

The present volume deals exclusively with the application to the thermodynamics of the reciprocating steam engines, of the temperature-entropy chart, or the energy chart, as the author prefers to call the diagram. The energy chart is plotted with the absolute temperature of the substance as the ordinate; when the absolute temperature has a different value the second ordinate is so displaced from the first that the area included beween the two represents, to a chosen scale, the energy expended or given off in changing the temperature. Since change in entropy is defined as the ratio of the change in energy of the substance to its absolute temperature, it follows that the abscissa is the entropy (or, as actually plotted, the change in entropy). The author limits the entropy scale on the chart to certain portions of the cycle of operations, and shows that thereby considerable practical use can be made of the energy chart. Much information is given concerning the methods of using the chart and the interpretation of the results obtained therefrom. It is shown that the temperature-entropy diagram gives all of the information obtainable from the pressure-volume diagram, and in addition shows the quantities of heat to be added or subtracted to obtain a certain transformation. It is interesting to note that in the temperature-entropy chart the heat area is bounded by finite lines and the work area by infinite lines; the reverse is the case in the pressure-volume diagram. The book should prove of interest and value to all who are interested in the thermodynamics of the steam engine.

Modern Engineering Practice. A Reference Library. Edited by Frank W. Gunsaulus, assisted by a corps of fifty-nine engineers. Chicago: American School of Correspondence. 12 volumes. 6,000 pages, 4,000 illustrations. Price, $60.

The material contained in these volumes has been compiled from selected instruction papers used at the American School of Correspondence in electrical, mechanical, stationary, marine and locomotive engineering, ship practice, tool making, forging, founding, pattern making, heating, ventilating, refrigerating, mechanical drawing, alternating-current working, electric lighting and wiring, telephony, etc. Although the instruction papers themselves were intended primarily for home study by ambitious young men who are unable to obtain a college education, and the books are well suited to the needs of such men, in no case does the matter appear to be excessively abridged or expanded, and the treatment is accurate throughout, so that the information contained in the volumes render them a valuable reference library for engineers.

Of the twelve volumes, five treat of subjects strictly electrical, a single exception being found in Vol. II, 98 pages of which are devoted to automobiles of all commercial types. The remaining portion of this volume contains a complete discussion of direct-current generators and motors and storage batteries. Vol. I gives a well-prepared and logically arranged treatment of the elements of electricity, the relation between magnetism, static electricity and dynamic electricity being pointed out in a manner to be readily understood by the reader. Seldom indeed is the connection between electricity at rest (static) and electricity in motion (dynamic) more simply and completely presented than is done in this volume. It is to be regretted, however, that a well-defined distinction is not made between "induced" static charges, "induced" electric currents and "induced" electromotive forces. In fact, the statements made in connection with the production of currents by induction are certain to lead to confusion in the mind of a reader not already familiar with the facts. The writer has added a statement under the discussion of the induction coil which may, perhaps, enlighten the reader concerning the physical facts, but on account of its position in the text this statement can serve only as a cure for ills which should never have been allowed to exist. No such confusion is found in the treatment of the alternating-current transformer, which treatment is, in fact, admirable in its simplicity and accuracy. The discussions of synchronous converters, motors and generators are sufficiently complete for all persons who are interested in the operation of such machines, but are not concerned with their design. Considerable space is devoted to single-phase and polyphase induction motors, the matter being handled in such a way that the reader for whom the books were intended will have no difficulty in obtaining just that information which he desires concerning the performance of these machines.

Of all of the electrical subjects none is given more space than telephony, to which 362 pages are devoted. The treatment of telephony contains a small amount of theory and a large amount of practical suggestions with reference to the installation, operation and care of the telephone apparatus and transmission circuits.

Fifty-nine pages of Vol. VI are devoted to an outline treatment of such elementary chemistry as should prove valuable to engineers in general. The remaining portion of this volume and the whole of Vols. VII and VIII deal with steam engineering in its various forms. Although thermodynamics receive some attention, the text is singularly free from all complicated discussions, and the matter is so presented that confusion cannot possibly arise as to the significance of the physical quantities involved. The steam turbine is treated briefly, perhaps too briefly. Refrigeration, however, is treated at great length and very effectively. Internal combustion engines are discussed with a degree of thoroughness entirely consistent with the purposes for which the books were intended. Boilers are treated from the viewpoints both of the designer and the user; the types described relate to stationary, marine and locomotive practice. Much information of value to the locomotive engineer is given concerning the operation of air brakes.

The matter relating to heating, ventilating and plumbing covers the selection, installation and care of the corresponding equipments, and the information given will prove useful to the architect, the builder and the workman. Of the subjects dealt with at length, none is treated more thoroughly than drawing in its various phases; in fact, Vol. XI may be considered as a complete treatise on this subject.

Among the more prominent features of the books may be mentioned an entire absence of difficult advanced mathematics, and a well-prepared list of review questions to test the reader's knowledge of the subjects he has covered. It is evident that no pains have been spared to render the books suitable alike for engineering students, mechanicians, electricians and practising engineers. The sixty writers whose combined labors are represented in the twelve volumes have accomplished in an admirable manner the task which they undertook to perform.

Largest Producer Gas Power Plant.

The new plant of the Iola Portland Cement Company at Dallas, Texas, is notable for the fact that it will have the largest producer gas power installation in the world. At other plants of the Iola Company, both gas engines and steam engines have been employed. The Loomis-Pettibone gas generating system, built by the Power & Mining Machinery Company, will be furnished in three units having a total capacity of 4,500 hp. Bituminous coal and Texas lignite will be the fuels used, the system being adapted to the gasification of either fuel without changes in the apparatus.

The Snow Steam Pump Works, of Buffalo, will furnish for

this plant four of their single-tandem, double-acting gas engines, each with a normal capacity of 1,100 B.hp. These engines will be direct-connected to alternating-current, 25-cycle electric generators of 810 kw capacity each, and will operate in parallel. Continuous operation, twenty-four hours per day, seven days per week, is required of the power plant. High efficiency is promised by the builders of the power apparatus and their guarantee is a kilowatt per hour at the switchboard from 1½ to 1¾ lb. of bituminous coal or from 2½ lb. of lignite, when operating at three-quarters to full load.

Wheatstone Bridge and Galvanometer Set.

The Wheatstone bridge and galvanometer set shown herewith has been designed for quick and accurate work, and is especially adapted for use in telephone and telegraph installations, central stations, colleges, etc. The set consists of a Wheatstone

WHEATSTONE BRIDGE AND GALVANOMETER SET.

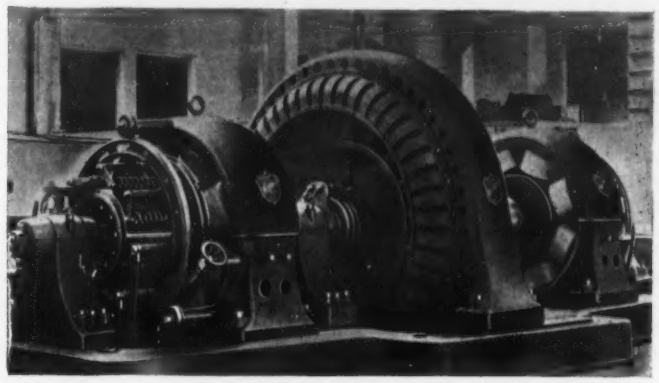
bridge, rheostat, D'Arsonval galvanometer, five cells of test battery, galvanometer keys, special switches for short-circuiting the keys and switch and binding posts. It is very compact.

The resistance is varied by means of leaf switches moving over platinum-faced contacts, which insures clean surfaces and no contact resistance variation. The galvanometer shunt and battery are mounted in a separate plate from the bridge and can be easily removed to make repairs or to renew batteries without molesting the coils or the bridge connections. The set is manufactured by Foote, Pierson & Co., 82 Fulton Street, New York.

Motor-Generator for Electro-Chemical Works.

The illustration herewith shows one of three motor-generator sets which will be used in an extension of the works of the Niagara Electro-Chemical Company at Niagara Falls, N. Y. The motor is of the synchronous type operated with 25-cycle current at 2,200 volts, the speed being 500 r.p.m. On each end of the motor there is driven by a flange coupling a 200-kw direct-current generator, the e.m.f. of which is capable of variation through a considerable range, the maximum value being 165 volts. Either generator can be disconnected in case repairs are necessary, without interfering with the operation of the reman-

ing machine. This characteristic of the set is necessitated by the severe requirements in the electrolytic reduction of metallic sodium from sodium hydroxide, which is an uninterrupted process



THREE-MACHINE ELECTROLYTIC MOTOR-GENERATOR.

and does not allow a complete shut-down at any time. The sets will be furnished by the Allis-Chalmers Company, Milwaukee, Wis.

Transformer Oils.

It is perhaps not generally realized what a difference there is in the quality of oils obtainable for a transformer insulation. The La Fayette Electrical Manufacturing Company, which makes the Hornberger transformer, recently tested 18 samples of oil as follows:

The tightly corked 8-ounce bottle in which each sample was placed was thoroughly shaken to insure perfect mixing. Some of the oil was poured into a clean, dry glass beaker. A hard rubber spark-gap with metal terminals, separated a distance of .075 in., was immersed in the oil. To the terminals of the gap were connected the secondary terminals of a 20,000-volt testing set. By means of a variable-ratio secondary winding and an auto-transformer in the supply circuit, it was possible to obtain voltages from 1,400 to 20,000 in small steps. The test was started with a low voltage, gradually increasing until breakdown occurred. The potential across the gap was measured by a voltmeter across the primary of the testing set. Care was taken to clean thoroughly the beaker and spark-gap after each test. The voltages required to break down the .075-in. air-gap in the several samples ranged all the way from 11,000 to 1,000. Three of the samples stood up under 9,000 volts and over. Five of the samples contained enough moisture to reduce the insulation strength to 50 per cent of the value of dry oil, taking the breakdown voltage of dry oil as 9,500 volts with a .075-in. air-gap. Nine of the samples contained sufficient moisture or other impurities to render them conductors rather than insulators, as they had an insulation strength below that of ordinary dry oil. The presence of any one of these nine oils in a transformer would, therefore, be injurious rather than beneficial to the insulation. It is almost needless to say that in view of these tests Hornberger transformers are supplied with an oil which is rigidly tested to ascertain whether all moisture has been eliminated. In this connection the company is bringing before central station managers the vital point of properly caring for transformer oil. In a recent case which came under its observation a man received a barrel of transformer oil and thought the best plan for storing it for a week was to roll it into a lake adjacent to the electric light plant. As the oil was in a wooden cask it absorbed through its immersion enough moisture to ruin its insulation properties.

The Hornberger transformers have insulation around the cores of a non-carbonizing mica composition. Between the primary and secondary windings the insulation is a heavy Fuller board reinforcing a heavy mica shield. The secondaries are wound with a multiple of square wires, thus utilizing all winding spaces and reducing current losses in the copper. Hornberger transformers are all oil-cooled. Those of above 250 kw in size have water-cooling coils suspended from the containing case cover into a large body of oil over the transformer winding.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The weather conditions last week favored distribution of seasonable merchandise at retail, but they increased trade difficulties. Freight blockades and the shortage of motive power not only retarded business, but threatened serious results at some Western points. Holiday trade has equalled the most sanguine expectations. There was a brisk demand for staple articles, which has depleted stocks to such an extent that the wholesale trade experiences unusual activity for this season of the year. Numerous advances in wages are reported, and the only noteworthy decrease in comparison with activities a year ago appears in building permits. Most industrial work is maintained at the maximum, mills and factories having so many contracts for next year's delivery that inventories receive little attention. Railway earnings thus far reported for December surpass those of last year by 9.6 per cent. Little change in the price of iron is noted, the market having developed a little of the quiet that is seasonable. In finished lines specifications are very heavy. In the primary markets for textile goods the event of greatest interest is the strength of cotton and the practical impossibility of securing prompt deliveries from manufacturers. Copper made two or three advances during the week, closing with a net gain of about ⅜ of a cent, thus establishing new high record prices. Lake closed at 23 9/16; electrolytic, 23¼, and casting stock, 23. A bid of 23½ cents for 1,000,000 pounds of lake copper was turned down Wednesday. Aside from this there are inquiries, made known within the last two days of the week, for several million pounds more of the same grade, consumers willing to pay 23½ cents, but this want has not yet been satisfied. Sales of electrolytic have been made into July, but the announcement of this contract for delivery into the last half of next year is not likely to be followed by other producers and sellers who at the moment are even more cautious than usual. *Bradstreet's* reports 227 business failures during the week ending December 20, against 220 in the previous week and 235 in the corresponding week of last year.

NEW GENERAL ELECTRIC FOUNDRY.—Note was made recently of the enlargement of the General Electric turbine shops at Schenectady. With this goes increase of foundry capacity. The additions to the main building and cleaning room make the main structure, 140 by 880 ft., with a wing, 120 by 170 ft., besides the gantry crane which covers the 50 by 450 ft. flask storage yard. The employees in this shop now number 1,030; the building contains 214,000 sq. ft. of floor space; number of cupolas, 5; tons of casting produced a week, 550. The number of castings produced a week is 45,000. Compressed air is now utilized in almost every operation connected with the making of a finished casting. While the work is actually done by compressed air, the air is supplied by a number of motor driven compressors of various capacities. The air is supplied at 80 lb. pressure. A compressor of 1,700 cu. ft. a minute capacity, driven directly by a 225-hp 10,000-volt motor, renders the iron foundry independent of the general compressed air service. On the main floor 63 molding machines, in constant use, are driven by the compressed air. The cars in the eight core ovens are operated in the same way.

THE WESCO SUPPLY COMPANY, of St. Louis, Mo., has purchased the plant of the Davis Electric Manufacturing Company, of Springfield, Mass., including all machinery and all the finished and unfinished product, which it is removing to St. Louis, where it will continue the manufacture of the Davis switches as well as all of its other specialties. The five-story factory building at the corner of Eighth Street and Clark Avenue, St. Louis, has been leased for a term of years and is being equipped with the latest and most modern machinery and other apparatus for the manufacture of these specialties as well as tablet boards, cut-out cabinets, switchboards, telephone and telephone accessories. It is the company's purpose to have one of the most complete modern and up-to-date factories for the production of electrical specialties in the West, and the name is a guarantee for the product of this factory. The plant will be in complete operation by January 15, 1907.

THE VIRGINIA PORTLAND CEMENT COMPANY, of Fordwick, Va., is about to add 2,000 barrels per day capacity to its plant, which will be one of the largest cement plants in the South. Many improvements will be made in the buildings and machinery; there will be a new power house, and the existing mill will be driven by electricity. In the power house two steam turbines are to be installed and the boiler capacity increased by 1,500 hp will now aggregate 2,000 hp. The whole of the old and new machinery will be driven by electricity. The consulting engineers of this plant are W. S. Barstow & Company, of New York and Portland, Ore. Barstow & Company have also been retained as consulting engineers for the new plant of the Seneca Button Co. at Poughkeepsie, N. Y., which is to be operated electrically throughout, and for the Bergen Point Chemical Works, Constable Hook, N. J., which are about to be equipped with a new light and power plant.

SALES OF FLEMING ENGINES.—The Harrisburg Foundry & Machine Works report increasing sales of self-lubricating engines in Chicago and the Middle West. The company has been awarded the contract for a 400-hp Fleming four-valve engine for the New York Life Building in Chicago, which will be direct-connected to a 225-kw generator. Hundreds of thousands of horsepower are in service in such well-known places as the Great Northern, the New Brevoort and the Windermere Hotels, the New Boston Department Store, the Heyworth, the Eastman Kodak and the Fort Dearborn Buildings in Chicago. At the present time, the company is installing 900 hp more in the Boston store and a 2,000 hp plant in the Auditorium Annex Hotel. One of the most recent contracts was with the Congress Hotel Company for three four-valve engines. One of these will be direct-connected to a 250-kw generator, while each of the others will drive a 350-kw generator.

THE COPPER MARKET.—Last week the United Metals Selling Company advanced its quotation for electrolytic copper to 23¼ cents. This company has sold some copper into May and at prices not far below the level now ruling. For Lake the United Metal's price is about one-eighth higher than electrolytic. A representative of one of the leading metal selling agencies says: "The copper situation is a remarkable one. It is marvelous every day to get continued inquiries for copper, more so from Europe than from this country where trade is quiet at the present moment. It is claimed that consumption in certain lines has fallen off and there is no question about it, but against this falling off in some of the minor lines there is an increase of 20 per cent to 25 per cent in the electrical lines. This latter will considerably more than offset the decrease in sheet copper or in some of the brass goods."

DUTY ON RADIUM.—The classification to be given to radium under the Dingley tariff has been in dispute. The present tariff law, enacted in 1897, makes no specific mention of radium, this product not having been known at the time. The General Appraisers have decided that radium is a chemical salt, and dutiable at 25 per cent ad valorem. A protest was made by the New York importers, H. Lieber & Company. Although the quantity of radium was exceedingly small, the importation has a value of several thousand dollars. The importers said free entry should be accorded, as radium was a crude mineral. General Appraiser Wilbur F. Lunt, who wrote the opinion, after consulting many authorities, says: "The merchandise is radium bromide, which we find to be a chemical salt and correctly assessed as such. The protest is overruled."

POWER FOR BAR HARBOR.—The Bar Harbor & Union River Power Company begin work at once upon the development of the power of Union River at Ellsworth, Me. The plans contemplate a concrete dam over sixty feet high, with power house containing modern hydraulic and electrical equipment. Mr. J. A. Leonard, Ellsworth, Me., is engineer of this company, and Messrs. Sellers and Rippey, Philadelphia, are consulting engineers.

PUMP PRICES.—We are in receipt of the following official announcement: "The International Steam Pump Company has been compelled, by the steady advance in the cost of raw materials, to increase the prices of its products. This policy has been adopted by all other manufacturers of machinery."

THE CHASE-SHAWMUT COMPANY, of Newburyport, Mass., has recently disposed of its patented switchboard interests to James S. Pennefather, of New York, and will concentrate its energies on its growing business in electrical supplies.

Financial Intelligence.

THE WEEK IN WALL STREET.—The restoration of a surplus in bank reserve on Saturday was received in Wall Street in a somewhat characteristic manner, resulting in a violent decline of prices of stocks. Judging by the precedent of recent months, this was to have been expected, for nothing has happened with more uniformity since the upward movement of August and September received its definite check, than a fall in the market on each occasion when actual news of a long predicted favorable event was given out. Reading was the focus of weakness from the start, and other stocks gave way instantly after the news of the restored surplus. The market closed in a demoralized condition with prices at the lowest points. The electric and traction stocks suffered to a slight extent with the rest of the market, but no heavy declines are noted, the greatest being in General Electric, which lost 3 points, the closing quotation being 157. The two issues of Allis-Chalmers declined a fraction, but Westinghouse remained steady and practically unchanged at 151. Metropolitan Street Railway made a gain of ½ point, which is the only gain in the list of electrics, and closed at 106½. On the curb market prices were generally lower, though they rallied a little from the early sharp break. The demand for mining issues has materially diminished, thus lessening a serious speculative danger. Following are the closing quotations of December 24:

NEW YORK

	Dec. 18	Dec. 24		Dec. 18	Dec. 24
Allis-Chalmers Co.	16⅛	16¾	General Electric	158	156¾
Allis-Chalmers Co. pfd.	43⅜	43⅜	Hudson River Tel	...	...
American Dist. Tel	25	...	Interborough Rap. Tran	...	...
American Locomotive	71	71¼	Mackay Cos.	71	70¼
American Locomotive pfd.	110	109¼	Mackay Cos. pfd.	67⅛	67⅛
American Tel. & Cable	85	83	Marconi Tel	...	...
American Tel & Tel	...	...	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit	79⅝	78¼	N. Y. & N. J. Tel	...	...
Electric Boat	30	31	Western Union Tel.	85	83¾
Electric Boat pfd	70	74	Westinghouse com.	148	149
Electric Vehicle	...	...	Westinghouse pfd	...	...
Electric Vehicle pfd	...	...			

BOSTON

	Dec. 18	Dec. 24		Dec. 18	Dec. 24
American Tel & Tel	136	135	Mass. Elec. Ry. pfd	69	68
Cumberland Telephone	...	...	Mexican Telephone	...	...
Edison Elec. Illum	...	230	New England Telephone	128	...
General Electric	...	...	Western Tel & Tel	9	...
Mass. Elec. Ry.	...	18⅛	Western Tel. & Tel. pfd	..	80

PHILADELPHIA

	Dec. 18	Dec. 24		Dec. 18	Dec. 24
American Railways	51	50½	Phila. Electric	8	7¾
Elec. Co. of America	11¼	11	Phila. Rapid Trans	22⅝	22⅝
Elec. Storage Battery	68	65	Phila. Traction	96¼	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Dec. 18	Dec. 24		Dec. 18	Dec. 24
Chicago City Ry.	160	150	National Carbon	85	85
Chicago Edison	...	...	National Carbon pfd.	115	116
Chicago Subway	44	...	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd.	...	...
Metropolitan Elev com.	28½	28½			

*Ex-dividend

DIVIDENDS.—The directors of the American Telephone & Telegraph Company have declared a regular quarterly dividend of 2 per cent, payable January 15. The directors of the American Cities Railway & Light Company have declared an initial dividend of 3 per cent on the preferred stock for the six months ending January 1, 1907, payable January 1. The directors of the Manila Electric Railroad & Lighting Corporation have declared the dividend of 1 per cent on the capital stock, payable January 10. An initial semi-annual dividend of $3 per share has been declared on the 6 per cent preferred stock of the Columbus Electric Company payable January 1, 1907. The directors of the Electric Storage Battery Company have declared the regular quarterly dividend of 1¼ per cent on the common stock, and 1¼ per cent on the preferred, payable January 2. The directors of the Reading Traction Company have declared the regular quarterly dividend of 1½ per cent, payable January 1, 1907. The directors of the De-Long Hook & Eye Company have declared the regular quarterly dividend of 2½ per cent, payable January 2. The directors of the Consolidated Traction Company of New Jersey have declared the regular quarterly dividend of 2 per cent, payable January 15. The directors of the South Side Elevated have declared the regular quarterly dividend of 1 per cent, payable December 31. The directors of the Bell Telephone Company of Philadelphia have declared the regular quarterly dividend of 1½ per cent, payable January 15. The directors of Westinghouse Electric & Manufacturing Company have declared a regular quarterly dividend of 2½ per cent upon the preferred and the assenting and non-assenting stocks, payable January 10, 1907. The directors of the Chicago Telephone Company have declared the regular quarterly dividend of 2½ per cent, payable December 31. The directors of the Tri-City Railway & Light Company have declared a quarterly dividend of 1½ per cent on the preferred stock, payable January 2. Manning, Maxwell & Moore, Inc., have declared the regular quarterly dividend of 1½ per cent on the capital stock, payable December 21. The directors of the National Carbon Company have declared the regular quarterly dividend of 1 per cent on the common stock, payable January 15. The directors of the United Gas & Electric Company of New Jersey have declared the regular semi-annual dividend of 2½ per cent on the preferred stock, and the regular semi-annual dividend of 2 per cent on the common. Both dividends are payable January 15. The New Brunswick (N. J.) Light, Heat & Power Company has declared a dividend of 1 per cent on the capital stock, the amount fixed in the lease.

NATIONAL WIRE CORPORATION.—At New Haven, Conn., on December 19, on the allegation that it is in debt more than $2,000,000, the National Wire Corporation was put in the hands of receivers. The receivership was instituted at the request of the National Steel & Wire Company, of Portland, Me., which is the holding company of the local concern, and other similar plants in Maine and in Columbus, Ohio. In petitioning for a receiver the Maine company, aside from alleging that the local concern is more than $2,000,000 in debt, asks that if the corporation cannot raise new capital to carry on the business, it be dissolved and its affairs wound up. The Maine company asks that Henry L. Hotchkiss, president of the L. Candee Rubber Company, of this city, and Homer Wise, of New York, vice-president of the Maine company, be named as receivers temporarily. To this motion Judge Thayer acquiesced, and named these two men as receivers and required that a bond of $150,000 be furnished by each. The plant of the National Wire Corporation is one of the largest of its kind in the East, and its organization dates back to 1870. When the plant was running full it employed 1,500 hands, but recently not more than 800 have been working there. The balance sheet of the company on November 26 showed it to be solvent, and also detailed its capital stock and other liabilities. The total assets are given as $9,625,379, and the surplus is given as $94,445. Following are some of the items in the liabilities column: Preferred stock, $3,633,700; common stock, $3,875,816; special loans of directors, $1,372,125; accounts payable to controlled companies, $305,689; bills payable, $286,768, and reserve for unpaid dividends, $56,834.

GENERAL ELECTRIC EARNINGS.—Representatives of the General Electric Company state that the gross business of the corporation for the fiscal year ending January 31, 1907, will not fall short of $58,000,000, an increase of about $13,500,000 over the preceding year. Assuming that these figures will prove correct, the net earnings of the corporation, based on the percentage of net earnings to gross in the two preceding years, will not fall short of $9,600,000. In the fiscal year ending January 31, 1906, the General Electric Company revealed net earnings of $7,319,161, which figure was equal to 16.5 per cent of the gross business of $44,419,613. Net earnings in the fiscal year ended January 31, 1905, were $6,719,546, or 16.6 per cent of the gross business of $40,323,354. If the General Electric Company does a gross business of $58,000,000 this year, and its net represents 16.5 per cent of the gross, it will have earned $9,570,000. Recent comparisons of the capital and earnings, dividends of the company are unintentionally unfair, as they overlook the fact that the capital was doubled a year or two ago by the restoration to the stockholders of all that was involved in the reduction of capital a decade back.

WESTINGHOUSE IN ITALY.—It is stated that the Westinghouse interests are about to build a big plant in Italy, in anticipation of obtaining some of the big contracts now pending there for the electrification of Italian steam railways. A combination was recently effected between the Societe Anonyme Westinghouse of Paris, the five-million-dollar concern which takes care of the Westinghouse business in Continental Europe outside of Germany, and the seven-million-five-hundred-thousand-dollar Milanese Company. The Westinghouse plant will be built adjacent to the car and locomotive shops of the Ernesto Breda Company of Milan. The new works will cost $1,000,000. An interest in the Breda Company has also been acquired by the Westinghouse Company. The capital of the Breda Company was increased to $2,500,000 by the issue of $1,200,000 additional stock, half of which was taken by the Westinghouse interests. It will be remembered that not long ago the Finzi single-phase system of motors and traction in Italy was acquired.

GENERAL NEWS.

Construction News.

GADSDEN, ALA.—Surveys are now being made for the proposed power plant of the Little River Power Company on Little River. It is proposed to develop 20,000 hp, which will be transmitted to the nearby towns for lighting and power purposes. J. A. Lathram, of Providence, R. I., is chief engineer.

NORTH BIRMINGHAM, ALA.—It is said that the Birmingham Railway, Light & Power Company is making plans to connect North Birmingham with Thomas by an electric railway, also touching the North Highlands line at its terminal. The company has recently purchased property between the two places with the purpose of constructing a power house.

PARADISE, ARIZ.—A telephone line from Portal to Douglas is contemplated. A company is being formed, with a capital of $25,000, to build the line. W. C. Hogan is president, J. A. Landowski, of Douglas, is vice-president and manager.

POMONA, CAL.—Howard E. Huntington has been granted a 50-year franchise by the Board of Trustees to construct and operate an electric railway over various streets in the city.

SACRAMENTO, CAL.—George N. Randle, City Surveyor, writes that the question of constructing a municipal electric light plant is being discussed by the public and different city officials at the present time, and the Mayor has recommended it to the Board of Trustees, but nothing definite has yet been decided upon.

LOS ANGELES, CAL.—S. M. Haskins has secured a franchise for the Los Angeles Interurban Railway Company at Glendale, for $275. It is said that the route is a part of the survey for the proposed extension of the Los Angeles Railway Company through Eagle Valley and Glendale and will be turned over to the latter by the interurban people.

LAKEPORT, CAL.—H. V. Keeling, secretary of the Lake County Electric Power Company has petitioned the Board of Trustees for a franchise for the installation of an electric lighting system in Lakeport. The company will secure its supply of electricity for distribution from the Snow Mountain Power & Water Company's plant on Eel River. M. S. Sayre is president.

PASADENA, CAL.—Heman Dyer, City Clerk, writes that contracts for material to be used in the construction of the municipal electric light plant have been awarded as follow: To the Western Lumber Company, for poles, $3.70 and $11.50 each; to B. F. Kiernlff, Jr., Company, for copper wire, $28 per 100 lbs., and to same company for cables, pins, for insulators, brackets, carbons, etc., and to H. L. Miller for arc lamps, transformers and switchboard panels.

LOS ANGELES, CAL.—After January 1 the three electric lighting companies operating in Los Angeles will make a reduction of 1 cent per kw-hour for lighting purposes. This reduces the basic rate from 11 cents to 10 cents and will enable the average householder to get his electricity for about 9 cents per kw-hour, as the rate is graduated according to the amount used. The companies will also make a rate of 6 cents per kw-hour for electricity used for heating purposes.

OROVILLE, CAL.—The Great Western Power Company has filed a mortgage to the Central Trust Company, of New York, as trustee to secure an issue of $25,000,000 in bonds. Of the issue $8,500,000 in outstanding. This company was recently incorporated under the laws of California with an authorized capital of $25,000,000 as the operating company for the Western Power Company, of New Jersey. The latter is a holding company with $18,000,000 authorized capital stock. Edwin Hawley is president of the company.

SAN FRANCISCO, CAL.—The announcement is made that the Western Power Company, a corporation allied with the Western Pacific Railroad, is negotiating for the purchase of the Pacific Gas & Electric Company, of San Francisco, which was formed recently by the consolidation of the San Francisco Gas & Electric, the California Gas & Electric and the Independent Electric Light & Power Companies. Besides its extensive holdings in San Francisco the gas corporation owns a system of power houses and electric railways in the northern part of the State, all of which are to be included in the sale. The Western Power Company controls one fork of the Feather River and has begun work on what is to be one of the largest power plants in America. Besides this, the Western Power Company has vast water rights in the northern counties of the State.

SILVERTON, COLO.—The Aninas Power Company has resumed operations after three months' suspension. The repairs of damages of the main plant, caused by a washout of pipe lines, cost the company a total of $50,000. Many mines in this district were obliged to partially close down while the plant was being repaired.

DENVER, COL.—The Colorado Central Power Company, in which David H. Moffat and Thos. F. Walsh are interested, is reported to be planning to construct three dams on two rivers in Colorado for the purpose of generating about 75,000 horse-power, which will be transmitted electrically a distance of from 150 to 200 miles to various points throughout the State.

MYSTIC, CONN.—The local electric light plant will be discontinued in a short time, and electricity will be furnished by the Westerly Company, when an all-day service will be established.

HARTFORD, CONN.—The Farmington Street Railway Company has given notice that it will apply to the incoming General Assembly for an extension of its rights, privileges and powers in its charter amendment for the construction of an extension of its lines.

DANBURY, CONN.—The Danbury & Bethel Gas & Electric Light Company will ask the General Assembly for authority to add $100,000 to its capital stock and $75,000 to its bonded indebtedness. It now has a capitalization of $200,000 and a bonded debt of $120,000. The company is planning to make extensive enlargements and improvements.

MYSTIC, CONN.—The officials of the Westerly Electric Light & Power Company, who control the Mystic plant, have applied to the selectmen of the town of Stonington for permission to have a new line of power wires cross the thoroughfares of the town. The plans of the company are to have extra wires strung for the purpose of furnishing heat and power as well as light along its line as far as Noank.

NORWICH, CONN.—A petition will be presented to the incoming Legislature, signed by Jeremiah Stark, William H. Geer, Clinton E. Stark and George E. Manning, asking for a charter for the Norwich, Colchester & Hartford Traction Company, to construct a new electric line between Norwich and Hartford, a distance of 38 miles. The petitioners will ask the right to develop water power, to construct power houses and to buy and sell electricity as well as an electric railway franchise.

WILLIMANTIC, CONN.—The South Coventry Street Railway Company has published a notice of its intention to apply to the General Assembly for a charter for an electric railway. The incorporators of the company are: W. L. Higgins, Andrew Kingsbury, E. A. Tracy, Addison Kingsbury and J. B. Carman, all of South Coventry. The line will run from Willimantic through the town of Mansfield, Coventry and South Coventry. Permission is asked to issue capital stock to an amount not exceeding $300,000 and also to connect with other lines, to run over the tracks of other companies, erect poles and wires, build a power house, etc.

WILMINGTON, DEL.—The street and sewer department, it is stated, has granted a franchise to the Delaware Electric Transmission Company to engage in the electric lighting business in Wilmington. The company which is affiliated with the new Commercial Light, Heat & Power Company, proposes taking the electric feature of the franchise of the latter company.

WASHINGTON, D. C.—Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 8, to furnish at the navy yards, etc., Newport, R. I.; New York, N. Y., League Island, Pa.; Annapolis, Md.; Washington, D. C.; Norfolk, Va.; and Guantanamo Bay, Cuba, a quantity of naval supplies, as follows: Schedule 322—battery cells, spare parts for motors, etc. Also until Jan. 22 to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., and the naval training station, San Francisco, Cal., a quantity of naval supplies as follows: Schedule 329—exhauster, motor, etc. Applications for proposals should designate the scedules by number. E. B. Rogers, Paymaster-General, U. S. A.

DEFUNIAK, FLA.—An electric lighting plant will soon be installed in this place. Malcolm Bruce is interested in the plant.

PENSACOLA, FLA.—The new plant of the Pensacola Electric Company is completed and is now furnishing electricity for operating the street railway system. The company is now in a position to furnish electricity for heat, light and power.

COLUMBUS, GA.—The power plant of the Columbus Railroad Company at City Mills is shut down for repairs, and the company is operating its system temporarily, by electric energy from the power plant of the Columbus Power Company at North Highlands.

WRIGHTSVILLE, GA.—The City Council has selected Arthur Paw, of Atlanta, to prepare plans and superintend the construction of water works, and an electric light plant, for which $35,000 in bonds were recently voted. Bids for the bonds will be received about Jan. 1.

GAINESVILLE, GA.—The town of Buford has contracted with the North Georgia Electric Company to furnish electricity to light the city, and work will be begun at once wiring the town. It is expected to start the plant at Dunlap Shoals at its full capacity January 1.

COLUMBUS, GA.—Bids will be received until Dec. 28 by M. M. Moore, Clerk of Council, for furnishing gas or incandescent lighting for bridges, guard rooms, engine houses, market, city hospital, council chamber and offices, etc., for the year 1907, beginning Jan. 1.

ATLANTA, GA.—Three routes have been surveyed for the Atlanta, Griffin & Macon Electric Railway, and plans have been perfected for the purchase of the equipment. The road is to be built by the Georgia Construction Company and will be one of the longest electric lines in the South.

ATLANTA, GA.—Chairman James L. Key, of the special committee, which is investigating the feasibility of the establishment of a municipal gas and electric lighting plant for Atlanta, has authorized the Hall-Illges Company, of this city, to make a survey of the city and furnish an estimate as to the probable cost of construction of a municipal gas plant which would supply the public at large, and an electric plant which would furnish light and power for the city only. An appropriation of $500 was made for this purpose.

COLUMBUS, GA.—It is claimed that 200,000 hp will be developed on the Chatahoochee River between Columbus and West Point, Ga. The

Columbus Power Company, a combination of all the power plants for some 20 miles above Columbus, is pushing the great development, and as fast as power is called for, dams will be built along the river, giving an almost continuous string of factories for twenty miles. A 975-ft. dam has also been built at Lover's Leap Falls, and another of large proportions will be built nearby. There are three dams within the city limits of Columbus.

BURLEY, IDAHO.—The County Commissioners of Cassia County have granted a charter to W. D. Kenyon, T. Bailey Lee, J. C. Rogers, Paul R. Kartzke and D. B. Hale for an electric railway to connect from the Snake River, one-half mile north of Burley to Oakley and the coal fields farther south. The road will be twenty-two miles in length.

CHICAGO, ILL.—A new power plant will be installed in the St. Anthony's Hospital at 119th Street and Marshfield Boulevard.

AKRON, IND.—The Akron Electric Light Company is in the market for a new boiler and other necessary equipment. A. A. Gast, president.

JOLIET, ILL.—It is reported that all private water rights in and around Joliet have been consolidated, and that $2,000,000 will be spent in developing a 15,000-hp plant.

CHICAGO, ILL.—The Congress Hotel Company has leased the property at 17-21 Congress Street, and will erect a 2-story building to cost $20,000. A power plant will be installed in the building at a cost of $200,000.

FT. WAYNE, IND.—The Kerr Murray works is installing a new lighting system throughout its whole establishment.

GREENWOOD, IND.—The Greenwood Water & Light Company has announced that it will remodel and re-equip its plant in this city.

MARION, IND.—The Marion Lighting & Heating Company has decided to extend its plant. William F. Thompson is chief engineer.

BLUFFTON, IND.—The City Council is contemplating making improvements to the water works and electric light plant, including the purchase of additional boilers.

NOBLESVILLE, IND.—A company is being organized in this city to supply Sheridan, Cicero, Arcadia and other towns with electricity for lighting and power purposes.

DANVILLE, IND.—The Danville Electric Light plant has been sold to James M. Lynch. Mr. Lynch announces that he will remodel the plant and add new machinery and equipment.

BROOKVILLE, IND.—The City Council has taken steps toward the erection of a municipal lighting plant and is now securing estimates for the same. The local light company is trying to sell to the city but the Council thinks it advisable to invest in a new plant.

TERRE HAUTE, IND.—Seven carloads of copper cable have been received by the Terre Haute Traction & Light Company, to be used in construction of the new extension of the St. Marys line to Paris. The cable was supplied by the American Electric Supply Company of Phillipsdale, R. I.

ANDERSON, IND.—The city administration has decided to consolidate the municipal lighting and the water works plants under one head or management, selecting Henry Drach as superintendent. The next step will be to purchase and install a new set of boilers to run both plants. Plans and specifications are now being prepared.

BETHANY, IA.—The citizens have authorized the issue of $16,000 in bonds to improve the municipal electric lighting plant.

CEDAR RAPIDS, IA.—The Cedar Rapids & Marion Telephone Company will rebuild the local exchange at a cost of about $40,000.

DES MOINES, IA.—The Muscatine & Council Bluffs American Electric Company is surveying for a line from Muscatine to Omaha.

MARSHALLTOWN, IA.—It is reported that the Marshalltown electric railway and electric lighting plant has been purchased by Hamilton Browne.

BOONE, IA.—The C. B. Sherman Company, of Boone, has been awarded the contract for building the power house of the Newton & Northwestern Railway at Fraser.

DES MOINES, IA.—Surveys are now being made for a new right of way for the new line of the Inter-Urban Railway Company from Des Moines to Carlisle, which the company will build this season.

WELLINGTON, KAN.—W. R. Savage, Mayor, writes that bids will probably be received in the spring for improvements to water works, to cost $30,000, and electric light plant to cost $10,000. No engineer selected as yet. A. B. Cheever is city clerk.

RUMFORD FALLS, ME.—The Rumford Falls & Bethel Railway Company has completed surveys and is now securing the right of way for an electric railway through Mexico, Rumford, Hanover, Newry and Bethel.

ELLSWORTH, ME.—The Bar Harbor & Union River Power Company will begin work at once upon the development of the power of Union River at Ellsworth. The plans contemplate a concrete dam over 60 ft. high, with power house containing modern hydraulic and electrical equipment. J. A. Leonard, Ellsworth, Me., is engineer of this company, and Sellers & Rippey, Philadelphia, Pa., have been retained as consulting engineers.

CUMBERLAND, MD.—It is reported that the Cumberland & Western-port Company will install a new 500-hp engine and boiler in the Clarysville power house.

HAGERSTOWN, MD.—The Hagerstown & Northern Railway Company will soon increase the capacity of its power house by the installation of two 150-hp generators. When these machines are placed the plant will have a capacity of 1,200 hp.

ROCKLAND, MASS.—The Abington & Rockland Electric Light & Power Company has decided to extend its lines to the North River bridge.

BOSTON, MASS.—The Board of Aldermen on Dec. 13 granted a franchise to the Metropolitan Home Telephone Company to operate an independent telephone system in Boston.

NORTH ADAMS, MASS.—A bill has been introduced in the Vermont State Legislature for the incorporation of the North Adams & Readsboro Street Railway Company. The proposed line is to run through Stamford to Hartwellville with authority to build later into Readsboro in one direction and through Searsboro to Woodford in the other. It is understood that the company will obtain its power from the "West Branch" of the Deerfield River between Hartwellville and Readsboro. The promoters of the enterprise are Readsboro and Stamford parties, it is understood. A bill has also been introduced incorporating the Wilmington & Whiting Traction Company. The charter, if obtained, will provide for the construction of an electric railway from the Massachusetts State line in the town of Halifax, through the towns of Halifax, Whitingham and Wilmington to Dover. The capital stock of the last named company is $100,000.

MT. CLEMENS, MICH.—The Edison Illuminating Company, of Detroit, has secured the contract to light the city for a period of 30 years.

HOLLY, MICH.—C. H. Baird of this city, who secured a lighting franchise and a contract to light the streets and to pump its water supply, has transferred his rights to the Holly Lighting Company, a new corporaiton organized for the purpose.

MIDLAND, MICH.—The Tittabawassee Power Company, capitalized at $1,000,000, has filed articles of association in Midland County. The incorporators are George G. Prentis, Theodore H. Hinchman, Jr., Lewis E. Flanders, Benjamin F. Mulford, L. M. White and William C. Manchester, of Detroit, and Lewis E. Rowley, of Lansing. The company is organized for the purpose of building dams and utilizing the power of the water of the Tittabawassee River at Edenville. Surveys have been made, plans prepared and lands to be overflowed purchased. Work on the first of a series of three dams will begin in the spring. The principal business office of the company will be located at Edenville.

PEQUOT, MINN.—A. M. Mathison, City Recorder, writes that it is proposed to construct water works and an electric light plant at a cost of $2,000 or $3,000.

DEER RIVER, MINN.—The Council Committee reports an estimated cost for an electric light plant at $8,725 and a steam heating apparatus for 4 blocks at $4,965.

CANNON FALLS, MINN.—The electric light plant of the Cannon River Electric Power Company has been destroyed by fire. G. S. Edmondstrom, Globe Building, St. Paul, Minn., is chief engineer.

TRACY, MINN.—The Electrical Machinery Company, of Minneapolis, has secured the contract to furnish machinery for the electric light plant at $9,165. A contract has also been awarded to George J. Cadwell & Co., of Minneapolis, for a 120-hp duplex compound American Ball engine and one 60-hp. simple American Ball engine, for the new electric light station.

WINONA, MINN.—Plans have been completed for the construction of a large hydro-electric plant on the Black River, near Hatfield. The dam will be 75 feet high, from the reservoir a canal will be constructed for two miles down the river, where a fall of 90 feet will be obtained and where the main power houses will be located. It is stated that funds for the enterprise have been provided and that plans will be soon submitted to contractors. The company expects to be able to supply electricity to Winona and La Crosse within a year. The company also contemplates the construction of an electric railway between this city and La Crosse. J. W. Booth is interested in the enterprise.

LOUISIANA, MO.—The Louisiana Light & Power Company has petitioned for a franchise to install an electric light, street railway and heating system. Arthur Ladley is interested in the project.

BELLEVILLE, MO.—The Village Trustees of Freeburg have granted the Belleville & Pinckneyville Traction Company a 20-year franchise to operate its electric lines in several streets in the village. The company proposes to build an electric railway between Belleville and Pinckneyville, passing through Freeburg.

TRENTON, MO.—The Public Service Corporation has had plans drawn for the erection of a three-story office building on Warren Street, also for a power house which will have double the capacity of the company's plant on Chauncey near Warren Street. The new buildings and the equipments will cost in the neighborhood of $500,000. The addition to the power house will be 50x100 feet. The addition will be a complete plant in itself and will have room for three 1,500-hp turbo-generator sets.

ANACONDA, MONT.—The Madison Power Company is reported interested in a company which proposes building a power plant on the upper Madison River, the electricity generated to be brought to Butte. The transmission line will be 150 miles long. It is stated that preliminary surveys have been made and an estimate of the cost completed.

ALBION, NEB.—A new engine of 100 hp is being installed in the electric light plant. H. Rice is owner.

LINDSAY, NEB.—It is reported that an electric lighting system is to be established in the town. A 40-hp engine and dynamo has been ordered.

LINCOLN, NEB.—The City Council has granted the Citizens Railway Company a franchise to extend its lines into the north and south sections of the city.

FRANKLIN, N. H.—On account of the low stage of the river many mills are using electrical instead of water power. The Webster Mills have recently installed electrical fixtures.

TRENTON, N. J.—The Citizens Local Telephone Company has filed an amended certificate increasing its capital stock from $10,000 to $125,000.

PRINCETON, N. J.—A new electric railway is to be built between Princeton and Kingston, over the Franklin road, and extending through to New Brunswick, a distance of twenty miles. It is understood that the Public Service Corporation is interested in the project.

LAMBERTVILLE, N. J.—With a view of operating an electric line between New Hope and Doylestown, the Lambertville Heat, Light & Power Company is contemplating leasing the turnpike owned by the New Hope & Doylestown Turnpike Company. If the deal is consummated the power station of the Lambertville Company will be erected at New Hope.

ARTESIA, N. M.—R. M. Ross, of Artesia, Cashier First National Bank, writes that estimates are now under consideration for the construction of a power plant on Penasco River. If favorable, a company will be organized at once. For further information address A. L. Ross, of Versailles, Mo.

FREWSBURG, N. Y.—Wm. T. Rahn is reported president of a company which is being organized for the purpose of establishing an electric light plant.

CANASTOTA, N. Y.—E. B. Roberts, village clerk, writes that the contract for lighting the streets for a period of 5 years has been awarded to the Central New York Power Company, of Utica.

ORISKANY, N. Y.—The Hudson River Power Company has completed the installation of the electric street lighting system in this village, and the arc lamps were lighted for the first time Dec. 15.

CORTLAND, N. Y.—The Cortland Traction & Power Company is installing a new lighting system and will be able to provide an all-night lighting service after Jan. 1, 1907. G. H. Maxwell is superintendent.

CALEDONIA, N. Y.—The Town Board, it is stated, has granted permission to the Niagara, Lockport & Ontario Power Company to use the town highways for the delivery of electricity for power, light and heat.

SYRACUSE, N. Y.—A certificate of merger of the Franklin Telephone & Telegraph Company with the Hudson River Telephone Company, has been filed at Albany. The Franklin Company serves the vicinity of Saranac Lake.

ADDISON, N. Y.—A franchise has been granted by the State Board of Railroad Commissioners to the Tuscarora Valley Traction Company, to construct an electric railway from Addison to Woodhull and Jasper, a distance of 19 miles. C. A. Brewster is interested in the project.

PORT HENRY, N. Y.—The Wetherbee, Sherman & Company is contemplating the erection of a power plant on Lake Champlain, to furnish electricity for operating its mines. The new power house will be located six miles from the mines. The electrical equipment will be furnished by the General Electric Company.

MOHAWK, N. Y.—The Board of Supervisors at Herkimer has adopted a report authorizing the committee on Military and Accounts to erect in the armory at Mohawk an electric lighting plant consisting of a gasoline engine, generator and storage batteries, with necessary foundations, belts and connections, the cost not to exceed $3,500.

BINGHAMTON, N. Y.—The officials of the Binghamton State Hospital have submitted the annual report to the State Commission in Lunacy at Albany, in which repairs and improvements to cost $203,200 are recommended; among which a new heat, light and power plant costing about $75,000 is the chief need; also the reconstruction of the lighting, heating and power plant, and a new heating system for main building, $75,000.

MEDINA, N. Y.—The contract for lighting the streets of the village with the A. L. Swett Electric Light & Power Company expires on January 1. At present the village pays $75 per lamp each year, and there are 83 lamps. The company has made a proposition to renew the contract on a basis of $70 per lamp, and the board of trustees has offered $55, which offer has been refused. The village officials have not refused the $70 offer, but will doubtless submit the matter to a special meeting of the taxpayers to be called in a few days.

SARANAC LAKE, N. Y.—Authority has been given by the State Commission of Gas and Electricity to the Saranac Lake Light, Heat & Power Company to sell its plant and franchises to the Paul Smith's Electric Light, Power & Railroad Company. The Paul Smith's Company has been granted permission to increase its capital stock from $100,000 to $500,000 and to issue $400,000 in bonds. It is stated that the proceeds of the mortgage bonds are to be used to meet the expense of constructing an electric railroad from Lake Clear station to Paul Smith's Hotel, and the construction of hydraulic and electric generating plants at Franklin Falls and Union Falls on the Saranac River. It is the company's intention to supply light and power in Franklin county villages.

ROCKINGHAM, N. C.—Press reports state that the Rockingham Power Company is about to let contracts for equipment in connection with its proposed development of the water power of Yadkin River.

FAYETTEVILLE, N. C.—Experts have given the opinion that the large dam at the Buckhorn Shoals on Cape Fear River, built for electrical development, will have to be taken down entirely on account of defective work which it is claimed renders the dam useless.

ASHEVILLE, N. C.—The Asheville Rapid Transit Company has been organized to take over the Asheville Loop Line to run to Burnsville, 3 miles from the terminus of the city lines. Chas. E. Van Bibber, of Walden, Mass., is interested, and the authorized capital is $500,000.

CHARLOTTE, N. C.—The Southern Power Company, in carrying out plans to develop more power at Rock Creek on the Catawba River, is extending its railroad from Fort Lawn, S. C., to Rock Creek, from Great Falls. It is estimated that 65,000 hp can be developed between Rock Creek and Fishing Creek, a distance of about 15 miles. The plant at Rock Creek will be completed by January 1, 1908.

BELLAIRE, OHIO.—An electrical plant for furnishing light and power is being installed at the Schick mines west of the city.

ELYRIA, OHIO.—Notice has been filed with the Secretary of State that the Dean Electric Company has increased its preferred stock from $500,000 to $1,000,000.

ELYRIA, OHIO.—The question of erecting a municipal electric lighting plant is now being considered and the city engineer has been instructed by the Council to prepare estimates. It is proposed to have 200 arc lamps.

DEFIANCE, OHIO.—The Northwestern Ohio Electric Railway Company, which proposes to build an interurban line from Defiance to Montpelier via Bryan, has made application to the City Council for a franchise for certain streets of the city.

DEFIANCE, OHIO.—The Auglaize River Power Company has applied to the City Council for a franchise to supply electricity in the city. The company proposes to construct a dam on the Auglaize River and erect a hydro-electric plant and furnish electricity to the manufacturing plants in the city.

LAKEWOOD, OHIO.—By a vote of four to two, the Village Council has voted to re-advertise the municipal light plant for sale, and if nothing prevents it will be disposed of to the highest bidder. Several attempts have been made to sell the plants, but all efforts in the past have resulted in a deadlock.

COLUMBUS, OHIO.—Announcement has been made that the East Liverpool Traction & Light Company, the Ohio River Railways Company and the Steubenville & East Liverpool Railway & Light Company, allied traction lines in the eastern part of Ohio, have sold an issue of $2,750,000 and extensive construction work will begin at once.

ALTUS, OKLA.—The City Council has accepted the new water works and electric light system, just completed at a cost of $50,000.

OKLAHOMA CITY, OKLA.—A new engine of 1,500 hp is being installed in the plant of the Oklahoma City Gas & Electric Company.

BAKER CITY, ORE.—The question of installing a lighting plant is being agitated.

ALBANY, ORE.—D. M. Cooper, of Albany, has applied to the recorder for permission to appropriate 100,000 cubic inches of the water of the South Santiam for the development of electricity for power and light purposes. A canal to be known as Knox Butte Ditch is to be built, to be 30 ft. wide at the bottom and 8 ft. deep and about 6 miles long.

PITTSBURG, PA.—The Council is considering the question of constructing an electric railway in Schenley Park, to be built and operated by the city.

PITTSBURG, PA.—The Bell Telephone Company has decided to entirely reconstruct its exchange in Pittsburg and rebuild its system in this city, which will cost from $100,000 to $200,000.

PHILADELPHIA, PA.—Watson & Huckle, architects of this city, are preparing plans for a large power house to be erected on the grounds of the Lutheran Theological Seminary at Mt. Airy.

LEWISBURG, PA.—The Borough Council has entered into a contract with the Lewisburg Light, Heat & Power Company for a term of three years, at a rate of $71.50 per lamp per year. The borough will reserve the privilege in the contract to cancel said contract if it is possible at any time to contract with another firm for light at a lesser sum.

NEWTOWN, PA.—An ordinance has passed first reading in the Borough Council granting a franchise to the Philadelphia Gas Construction Company, to light the streets and houses. Bids will be received until Jan. 7 by Henry Aufflerbach, chairman committee on light, for lighting the streets of the borough for a period of 3 or 5 years.

HARRISBURG, PA.—The American Union Telephone Company, a consolidation of nearly all of the independent telephone companies in Pennsylvania, Southern New York, Maryland, Virginia and West Virginia, was permanently organized at a meeting of its board of directors held in Harrisburg, Dec. 15. The officers are: Ellis Orvis, of Bellefonte, president; B. F. Meyers, of Harrisburg, vice-president; S. R. Caldwell, secretary and treasurer. F. D. Houck, of Harrisburg, was elected general manager.

ABBEVILLE, S. C.—The Savannah River Power Company has received 30,000 pounds of wire for its electric plant, which will soon be in operation to this point. The company will furnish electricity for lighting and power in this city.

HURON, S. D.—R. W. Clark, of this city, has applied to the Council for a franchise to build and operate an electric street railway in this place.

COLUMBIA, TENN.—The Columbia & Mt. Pleasant Interurban Railway has made application for a franchise to operate its line in this city.

NORFOLK, VA.—The Norfolk & Portsmouth Traction Company, operating the electric lighting system, is installing a new system of transformers in parts of its electric lines to improve the incandescent lighting system.

ALEXANDRIA, VA.—Electricity for lighting and other purposes is being furnished the city by the Alexandria Electric Company. The old plant, which has been for many years past operated by the city for lighting purposes only, will be closed down. The new company has completed its plant at the foot of Wolfe Street, which was formerly operated by the Osage Manufacturing Company. Many merchants have had their places of business wired for electricity.

LURAY, VA.—Electric lights for the famous Luray caverns near Luray, Va., are now assured, according to reports from Luray, which state that the Luray dam has been completed in the Shanandoah River at a cost of $62,000 and will generate sufficient power to light the town of Luray, and the Luray caverns. The plant is owned by residents of Luray and Page counties and many country homes will also be lighted by electricity.

WOOLEY, WASH.—W. R. Morgan, it is stated, has secured a 50-year franchise to set poles and stretch wires for conducting electric current along county roads.

NORTH YAKIMA, WASH.—The Pacific States Telephone & Telegraph Company is making extensive improvements to its system in this place, which, when completed, will cost about $250,000.

SPOKANE, WASH.—Secretary H. L. Bleecker, of the Washington Water Power Company, announces that the company will build a $2,000,000 electric power plant in Ross Park, on the river, in the eastern part of this city. The plant is expected to be ready August 1, 1907. When fully developed it will generate 30,000 hp.

CHEWELAH, WASH.—A six-mile electric railway will be built from Chewelah to the properties of the United Copper Mining Company, northeast of the town, at an estimated cost of between $30,000 and $50,000. The company has secured a water power site near Chewelah, which assures a minimum of 200 hp. Conrad Wolfle, of Spokane, is president of the company.

PASCO, WASH.—Howard Amon, of Kennewick, Wash., has applied for permission to use 11,000 cu. ft of water from Snake River at a point at the head of Five-Mile Rapids, about 5 miles east of Pasco. The water is to be used for developing power, and the work includes the damming of the entire Snake River, which will necessitate the construction of locks for navigation purposes. The cost of the dam, locks and power plants, it is stated, will be about $500,000. About 20,000 hp is to be developed. The power is to be used principally for pumping water to irrigate land in the vicinity of Richland, Pasco, and Kennewick, and the surrounding country.

MILWAUKEE, WIS.—The Wisconsin Rapid Transit Company is securing the right of way for its proposed line to Dartford.

GREEN BAY, WIS.—It is reported that bids will be received until Jan. 3 by the light committee for furnishing arc lamps of 1,200 and 2,000 candlepower for street lighting for a period of 10 years.

KILBOURN, WIS.—The La Crosse Stone Company, of La Crosse, has secured the contract to construct a dam in Kilbourn for the Southern Wisconsin Power Company, whose capital is $1,500,000. The ditch will be approximately 250 ft. wide, 500 ft. long and about 100 ft. deep.

CHEYENNE, WYO.—The Northern Colorado Power Company, which recently purchased the plant of the Cheyenne Light, Fuel & Power Company is contemplating the erection of a new electric light plant to replace the one now in use. It is stated that the plant will cost about $1,000,000 and will also provide electric energy for an electric railway system.

SARCOXIE, WYO.—The Sarcoxie Electric Light & Milling Company has increased its capital stock from $7,500 to $16,500.

FERNIE, B. C.—The Crow's Nest Pass Coal Company will erect a large power plant here during the winter. A. Aberil, hydraulic engineer, and J. O. Gallice, mechanical engineer, of the Allis-Chalmers Company, of Montreal, have been engaged in connection with the work. Address General Manager Lindsay.

CHEYENNE, WYO.—Sealed proposals will be received until Jan. 14 at the office of the constructing quartermaster, Cheyenne, Wyo., for constructing, plumbing, steam heating, electric wiring and furnishing and installing electric light fixtures in the buildings at Fort D. A. Russell, Wyoming: 4 sets of field officers' quarters, 3 double sets captains' quarters, 2 double sets lieutenants' quarters, 1 set of quarters for 6 unmarried officers, 1 double set for N. C. officers, 2 double sets field artillery barracks, or in lieu thereof: 4 single sets field artillery barracks, 4 field artillery stables, 4 artillery gun-sheds, 4 artillery shops and 2 artillery stable guard buildings; 1 veterinary hospital, 1 granary, 1 hayshed and 1 fire engine and hose cart house. Specifications and blank forms of proposals may be obtained at this office. Envelopes containing proposals should be indorsed, "Proposals, constructing, etc., buildings," and addressed V. K. Hart, Captain and Quartermaster, U. S. Army, in charge of construction, Cheyenne, Wyoming.

WINNIPEG, MAN.—The city is short of power for lighting the streets and every night half the streets are in darkness. Alderman Gibson states this is on account of the failure of the plant of the Winnipeg Electric Company to supply the amount of power contracted for by the city.

WINNIPEG, MAN.—Premier Roblin has instructed the provincial public works department to at once secure material necessary for the construction of 1,000 miles of telephone line. This is the initial step toward the building of government long distance lines all over the province. Address Francis Dagger, provincial telephone expert, Winnipeg, Man.

TORONTO, ONT.—The Provincial Government has cancelled the lease of the Chaudiere Falls Water Power Company on account of non-fulfillment of conditions.

MASSEY, ONT.—The Massey Light, Heat & Power Company has been incorporated with a capital of $10,000. The incorporators are: J. Brophy, J. N. Cameron and H. H. Flesher, of Massey, Ont.

FORT WILLIAM, ONT.—Superintendent Jones, of the electric light commission, recommends the placing of meters in all houses and blocks and the doing away of the flat rate not in force.

TORONTO, ONT.—The Nipissing Power Company has been incorporated here with a capital of $100,000, to supply electricity for light, heat and power purposes. The incorporators are: J. D. Montgomery, E. R. Lynch, J. P. Crawford, Toronto, Ont.

GALT, ONT.—The three years' agreement between the Council and the Galt Gas Light Company, for an all-night electric light service at 25 cents per lamp has been finally passed. The contract is terminable if in the interval Niagara power should be transmitted here.

WINDSOR, ONT.—The report of Louis H. Egan, the expert employed to give an opinion regarding the requirements of the proposed new electric light plant recommends that $18,000 be spent in repairs to the present plant, to consist of a new switchboard with 225 arc lamps.

WESTMOUNT, ONT.—The municipal electric light plant has been put in operation and is giving satisfaction. The arc lamps are of the magnetite arc type, of 2,000 cp. The total cost of the street and house lighting and incinerator service to the city of Westmount amounts to over $200,000.

WOODSTOCK, ONT.—The Hydro-Electric Power Commission's estimate of the cost of Niagara power for this town is $23 per horse-power per year. The present price of power as furnished by the city is $60 per hp flat rate, or $90 per hp meter rate. A by-law to accept power from the hydro-electric commission will be voted on by the ratepayers on Jan. 7.

BROCKVILLE, ONT.—The secretary of the Hydro-Electric Power Commission suggests to the Mayor that if Carleton Place, Perth, Smith's Falls and Brockville would join in making application for power the situation would warrant a development on the Mississippi River, ensuring a price much less than previously quoted to Brockville, which was based on an estimate received from parties owning a water-power privilege at Waddington, N. Y. The price was $24 per hp for a 24-hour service. The matter is being taken up by the new Board of Trade, which has been recently organized.

TORONTO, ONT.—On the ground of nonfulfillment of the conditions, the Government has cancelled the lease of the Chaudiere Falls water power, on the French River, granted in November, 1904, to Malcolm Macleod, of Toronto, and Joseph Eugene Serre, of Sturgeon Falls. One of the conditions was that the lessees should develop 3,000 hp within two years of the date of signing the lease, which had not been done. The Chaudiere Falls, which now revert to the Crown, are, it is said, capable of development up to between 7,000 and 8,000 hp. They are situated on the river at a point near where Lake Nipissing debouches into it. The nearest town of any size is North Bay, which is about fifty miles distant.

MONTREAL, QUE.—The Lake Champlain & St. Lawrence Ship Canal Company is reported formed to construct a canal between St. Johns and Montreal, also utilize a 74-ft. waterfall about 3 miles from Longueuil for power and manufacturing purposes. The directors are: Samuel H. Ewing, C. E. Archibald, Thomas Craig and others.

Company Elections.

LESTER, MICH.—At the annual meeting of the Lester Telephone Company the following officers were elected: T. E. Thompson, president; E. Drury, vice-president; G. Paradine, secretary; T. Follett, treasurer.

Legal.

RIGHTS UNDER PATENT OF ELECTRIC APPARATUS.—Though the advantages of a patent of an electric induction apparatus or transformer turns out to be different from the one chiefly in the mind of the patentee, the invention will not fail on that account, if there be in the concept an actual advantage and patentable invention is evinced. A patentee is entitled not only to what he specifically sees, but also to what has been brought about by his invention, even though not actually seen at the time of the invention. Kuhlman Electric Company vs. General Electric Company, United States Circuit Court of Appeals.

LIABILITY OF EMPLOYER TO EMPLOYEE INJURED BY DEFECTIVE MACHINERY.—An employee, engaged in the operation of a machine in a knitting mill, was allowed $500 damages in an action brought to recover for injuries received by reason of her clothing catching on shafting directly back of the place where she was working. The rule is that an employer must furnish his employee with a reasonably safe place in which to work and, in default of this, he is responsible for any injury which arises, which could have been obviated by the exercise of reasonable diligence on his part to discover the danger and guard against the injury. If, however, the danger is so obvious that the employee could remain in ignorance of it only by closing his eyes and refusing to see that which would be visible upon a cursory observation, then, if he is injured, he cannot hold the employer. Wallace vs. Bach, Court of Appeals of Kentucky.

RIGHTS OF PARTIES UNDER CONTRACT FOR SALE OF MACHINERY.—Where a contract for the sale of machinery defines the power and capacity of the machinery, the purchaser is not entitled to imply an agreement or warranty on the part of the seller that the machinery will be adequate for the purchaser's business, although the seller knew, at the time of the making of the contract, the purpose for which the machinery was to be used. This is the rule laid down in the case of Cleveland Punch & Shear Works vs. Consumers' Carbon Company, decided by the Supreme Court of Ohio. The plaintiff company contracted to furnish the defendant company with three hydraulic presses, to be used in the

manufacture of arc light carbons, a horizontal pump and an accumulator. The capacity and strength of the presses was definitely stated in the contract under which they were sold and it was held that the plaintiff company fully discharged its obligations when it furnished machinery of the designated power and capacity and free from defects.

ELECTRIC RAILWAY COMPANY'S LIABILITY FOR INJURIES TO EMPLOYE FROM DEFECTIVE APPLIANCES.—An employe of the South Jersey Gas, Electric & Traction Company obtained a judgment of $3,500 against the company as damages for injuries which he received in falling from the top of one of the company's cars. The plaintiff was a line and repair man and when a trolley wire broke along the line it was his duty to go at once to the scene of the break, make temporary repairs, and then return and take out the repair car and make the repairs permanent. On the day upon which he was injured he had climbed to the top of the repair car and was getting down after having made the repairs, when the grab iron on top of the car, of which he had hold, pulled out, causing him to fall. There was proof that the grab iron was faultily constructed, in that the screws which held it were too small and that it was defective owing to the fact that the wood, where it was fastened, was rotten. It was held that the plaintiff had a good cause of action against the company. McIsaac vs. South Jersey Gas, Electric & Traction Company, Supreme Court of New Jersey.

LIABILITY OF STOCKHOLDERS.—In the suit of the Security Trust Company of Toledo against the Columbia Telephone Manufacturing Company of Ottawa, the Ohio supreme court decided a few days ago that in the event of a settlement the holders of stock in corporations are liable for the face value of their holdings, no matter what the stipulations of the officers regarding their liability. The court further held that not even the charter of a company could limit the liability of stockholders to less than the face value of the stock they hold. The Columbia Telephone Manufacturing Company had a West Virginia charter, which stipulated that the liability on stock is limited to the amount actually paid in, but the supreme court seems to have thrown that condition aside. The charter of this particular company provided that after 50 per cent of the face value of the stock had been paid in, the stock should be considered as fully paid up. A large amount of the bonds of the telephone company were held by the Security Trust Company and it brought foreclosure proceedings. As a defense the charter of the company was set up, but the judges were unanimous in their decision in the matter and found for the trust company, which asked that the stockholders be held for their full liability. Last week the same court held that stock given as a bonus with bonds is liable to assessment up to the par value before other sources of revenue can be sought. These decisions will have great hearing upon what is known as watered stock, it would seem, and in the future stock actually sold will be held in higher esteem than it ever has been before.

Obituary.

MR. S. DODD.—Mr. Samuel Dodd, president of the International Silver Company, of Meriden, Conn., died last week suddenly of heart disease. He was born at Hartford in 1834, and became prominent in banking and silverware manufacture. At the time of his death he was treasurer and secretary of the Meriden Gas and Electric Light Companies.

MR. E. P. WRIGHT.—We regret to note that Mr. E . P. Wright, for many years superintendent of the Western Union Telegraph Company, with headquarters in Cleveland, Ohio, died there on Tuesday, December 18. Mr. Wright was 70 years old and was widely known. He severed his connection with the Western Union Company several years ago. He was vice-president of the Cleveland Telephone Company and a director of the Citizens' Savings & Trust Company.

MR. D. R. VAIL.—We regret to note the death of Mr. Davis R. Vail, son of Mr. Theodore N. Vail, the telephone and street railway magnate, who is returning to America this week for festivities at his splendid country house at Lyndon, Vt. Davis R. Vail died on Thursday last week of typhoid fever after only ten days' illness. From the first it was a complicated case, but it was hoped that his strong constitution would throw it off. When at Harvard Mr. Vail was guard on the university football team and in his senior year was captain of the college crew. He appeared, however, to have overtaxed his strength, for he speedily fell into ill health. We was admitted to the bar, but for the last three or four years found himself not able to practice continually. Mr. Vail was very fond of music and in reconstructing his house at Lyndon his father installed an organ of exceptional size for a private house. Mr. Vail was a member of the Union, University and Harvard Clubs.

Personal.

MAYOR ELLIS, of Ottawa, Can, has been appointed by the City Council as city assessment commissioner and secretary of the civic electric commission at a salary of $2,500 a year.

MR. E. H. MATHER, treasurer and manager of the Portland, Me., Lighting & Power Company, has severed his connection with that corporation and at the beginning of the New Year will become connected with the banking house of Geo. A. Fernald & Co., of Boston.

MR. E. L. TATUM.—Mr. Earl L. Tatum has been appointed city electrician of Manila, P. I. He is a native of Durham, N. C., and for several years was engaged in electrical work at Norfolk, Va. He secured an appointment in the Department of Engineering at Washington, D. C., under Capt. John S. Sewell, and was then transferred to the Government Printing Office. In 1904 he was transferred to the U. S. Bureau of Printing at Manila, and has held his position there up to the present time. He will make a trip home before assuming his new duties.

NEW YORK ELECTRICAL SOCIETY.—At the meeting of the New York Electrical Society on Dec. 19, the following-named gentlemen were elected to membership: John W. Brooks, Sydney F. Weston, Edward H. Waldo, F. P. Thorp, F. H. Leonard, Jr., Nathan Heischer, Albert C. Boeri, Aldred K. Warren, Chas. H. Hadlock and Kingsley G. Martin.

MR. A. KENNEDY.—The directors of the Pittsfield, Mass., Electric Company have elected Alexander Kennedy treasurer and William A. Whittlesey, superintendent. Mr. Kennedy is also president and will discharge the duties of both positions. Mr. Whittlesey under his late father, familiarized himself with the mechanical end of the business and he was the unanimous choice of the directors. He is a graduate of Cornell University.

MR. C. A. BLACHLEY has resigned as chief of the engineering and machine division of the U. S. Bureau of Engraving and Printing, Washington, D. C., and on January 1 will open an engineering office at Room 1052 Drexel Building, Philadelphia. He will devote his attention to light, heat and power propositions, commercial and industrial plants, machine tool installations, engine, boiler and electrical testing, economies and efficiences. Special attention will be paid to plans and specifications for the general supervision of complete mechanical and electrical installations.

ED. L. BARBER, of Wauseon, O., who has been chosen as manager of the proposed independent telephone plant at Chicago, has had an interesting career in the independent business. Since he demonstrated marked ability in the construction of the plant at Toledo some years ago, in connection with James S. Brailey, Jr., he has been considered one of the strongest men in the business and this appointment demonstrates the faith financial men have in him. Mr. Barber has built some of the best plants in the west and south and all of them have proved successful from the start.

MR. R. A. FLIESS, well known in the electric vehicle field, has become president of the Combined Experimental & Manufacturing Company, of 34 Mechanic Street, Newark, N. J., which is engaged in work such as is indicated by its title. It has, however, brought out recently something which belongs more in the commercial field in the shape of a small automobile weighing about 60 pounds, intended for the use of children, and which is propelled by the tension of a large steel spring as its source of energy. There seems no reason why this ingenious little device should not find a general reception. It is completely equipped in every respect.

MR. WALTER C. PEARCE, of Troy, N. Y., has been made superintendent of the Cortland, N. Y., Traction & Power Company, in place of Mr. G. H. Maxwell, resigned on account of ill health. Mr. Pearce is a son of Rev. W. H. Pearce, formerly a pastor of the Methodist Church at Cortland. Mrs. Pearce is a daughter of H. M. Kellogg, who was formerly with the local company, but more recently has been with the Beacon Electric Company, of Troy. Work on the new lighting system will begin at once under the supervision of Mr. Pearce. The system will be installed before January 1, 1907, and on and after that date the city will be provided with all-night lighting.

MR. T. NEVINS, of Orange, is an interesting and growing personality in the electrical field, full of activity and energy, with a swift and keen business eye. The *Wall Street Journal* says: "One of the men who have gone into Cobalt mining enterprises is Thomas Nevins, who has been heretofore known mainly as a constructing engineer for gas, electric light, and street railway properties. Mr. Nevins achieved some fame as a young man of only twenty-one years by consolidating the lighting companies of Newark and the Oranges, and then selling them to the Public Service Corporation. He has also been interested in street railway enterprises in New Jersey, and owns some large interests in Texas oil companies, the stock of which has never been offered to the American public, and which is largely held in England."

Trade Publications.

AIR BRAKES.—Much information concerning the construction details of Christensen straight air brake equipment is given in Bulletin No. 1508 of the Allis-Chalmers Company, Milwaukee, Wis.

LOCKERS.—The Narragansett Machine Company, Providence, R. I., has issued catalogue GA, containing lists of stock sizes of steel and wood clothes lockers for factories, power houses, etc., and descriptions of parts, locks, benches and other accessories.

STARTING AND FIELD RHEOSTATS.—In circular No. 1139, the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., gives an outline of the requirements with reference to starting and field rheostats, and shows the extent to which these requirements have been met by its various standard forms.

AIR COMPRESSORS.—In catalogue No. 20, of the Chicago Pneumatic Tool Company, all of the details of construction and operating characteristics of Franklin air compressors are discussed at great length. It is interesting to note that the demand for electric motor drive with air compressors is constantly increasing.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is sending out to the trade circulars descriptive of its "Duplex" lamp guard. One of the features of the "Duplex" is that it does not require removal from the socket to insert or withdraw the lamp. It is strongly made of carefully tinned wire, and the attachments are made of clamping springs which effectually prevent guard slipping from the socket or opening and exposing lamp to injury. It will enclose either a 16 cp or a 32 cp incandescent lamp. The Central Electric Company will be glad to quote prices on request.

News of the Trade.

THE PHOENIX GLASS COMPANY, owing to the increase in its business in Chicago, will move to new and larger quarters. From the beginning of January it will be located in spacious offices and salesrooms at the Heyworth Building, Madison street, and southwest corner of Wabash avenue, where it will be glad to welcome old friends and new customers.

THE HILL-WRIGHT ELECTRIC, INC., of 105-107 Reade Street, New York City, reports large orders on hand. This company has recently made several contracts for very large quantities of burnt out lamps and anticipates an even greater business than usual. It expects to move into larger quarters about Feb. 1, and will enlarge its equipment, making its capacity about double what it now has.

THE POWER AND MINING MACHINERY COMPANY, of Cudahy (suburb of Milwaukee), Wis., in conjunction with the Snow Steam Pump Works, of Buffalo, N. Y., has opened a new sales office at 719 White Building, Buffalo, where will be handled the several types of gas generating apparatus, such as the Loomis-Pettibone system, suction and pressure gas plants, built by the Power & Mining Machinery Company, and the Snow gas engines, built by the Snow Steam Pump Works. Mr. Seward Babbitt, the sales maanger of the first named concern, will make his headquarters at the Buffalo office, on account of the facility for conducting business from that point.

THE POKE BONNET WINDOW REFLECTOR, which has been on the market but one year, has proven itself a popular window lighting device. Among the retailers recently installing these reflectors are: Beall-Livingston Co., Columbus, O.; Johnson-Morgan Co., Louisville, Ky.; Symons D. G. Co., Butte, Mont.; B. Siegel Co., Detroit, Mich.; Burnham & Phillips, New York City; Hanover Shoe Co.; Surprise Clothing Co., New York City; Central Dept. Store, Los Angeles, Cal.; Denver D. G. Co., Denver, Col.; Z. Paquet, Quebec, Canada; National X-Ray Reflector Co. The company claims to have sold over 20,000 reflectors this past season. Besides a removal of its factory, the company will occupy a new display salesroom after Jan. 1 at 347 East Jackson Boulevard, Chicago, being much more conveniently located than its present quarters.

THE NATIONAL X-RAY REFLECTOR COMPANY.—A new factory is being erected at 348-350 West Jackson Boulevard, Chicago, for the National X-Ray Reflector Company. This building will be known as the Curtis building, and is being put up by the president of the above mentioned company to provide new and enlarged quarters for its rapidly growing business. It will give the company three times the space of its present quarters. This building has attracted considerable attention among engineers and architects because of the peculiarity of its construction and its being the first of its kind erected in Chicago. The construction is what is known as the "umbrella system of reinforced concrete." The floors and pillars of concrete are strengthened inside the concrete formation by steel rods. There is not one timber to be used in the entire building, and it is consequently absolutely fireproof. It is located on one of Chicago's main arteries, Jackson Boulevard, and has light on all sides. It will probably serve the National X-Ray Reflector Company for many years to come.

H. W. JOHNS-MANVILLE CO.—In order to handle to the best advantage its large and rapidly increasing business in that section, the H. W. Johns-Manville Co., of New York, will open a New Orleans branch on Jan. 1. This will consist of a large retail store, offices and warerooms, located in the large three-story building at the corner of Baronne and Perdido Streets. This company is well known as being the largest manufacturer of asbestos and magnesia products in the United States, if not in the world. It also manufactures a large line of electrical specialties. Mr. W. E. Carpenter, formerly well known as the local manager of the Western Tube Company, has been appointed as manager of the New Orleans branch. The company proposes carrying a large stock of its products constantly on hand, so that shipments can ordinarily be made from New Orleans stock, including such well-known products of the company as asbestos roofing and insulating materials, steam pipe and boiler covering, asbestos packings of all kinds, "Noark" fuse devices and other well-known electrical devices manufactured by the company.

THE ELECTRIC SERVICE SUPPLIES COMPANY announces that it has secured in addition to its former territory, the States of Michigan, Ohio and Indiana for the complete line of Locke insulators manufactured by the Locke Insulator Manufacturing Co., of Victor, N. Y. The high quality of Locke insulators is well known to the trade. Customers in the above territory desiring information on this material are assured that their inquiries will receive prompt and personal attention. The accurate knowledge of the engineers in the Locke factory concerning the qualities and characteristics of the constituents of their insulators, makes it possible for them to predetermine the exact electrical and mechanical strength of their product, even before the insulators are completed. Such results are the outcome of a great range of tests such as this company carries on. Continuel tests may at first seem as unneccessary item of expense, however the Locke company has been convinced that only by means of such tests can it be absolutely assured of uniformity in its insulators. Such tests are made both mechanically and electrically, and request is made for inquiries as to new demands and problems in this field.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 18, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

838,525. TESTING SYSTEM FOR TELEPHONE LINES; William W. Dean, Chicago, Ill. App. filed June 29, 1903. In a telephone system, the combination with telephone-lines, of operator's connecting cords and plugs, a plug-seat switch for each plug, a supervisory relay associated with each cord, a testing-conductor common to the cords, said testing-conductor being connected with the cords through contacts of the associated plug-switch and disconnected therefrom through the contacts of said relay, substantially as described.

838,542. RAILWAY SIGNALING APPARATUS; Albert J. Hitch, Ridgetown, Ontario, Canada. App. filed Dec. 4, 1905. A complete railroad signal system having special trolley wires laid on both sides of the usual track rail and adapted to make contact with depending rollers on the train. Has a special construction of signal boxes, etc.

838,545. MULTIPLE TELEGRAPHY AND TELEPHONY; Maurice Hutin and Maurice Leblanc, Paris, France. App. filed May 9, 1894. The method of tuning electric circuits which are in inductive relation to a line upon which alternating currents of different frequencies are simultaneously forcibly impressed, which consists in rendering zero the real reactance of each circuit for the current which it is to receive, substantially as described.

838,547. ELECTRIC MOTOR AND METHOD OF CONTROLLING THE SAME; Austin Kimble, Chicago, Ill. App. filed May 21, 1906. A system for winding the fields of a small motor in several sections so that the speed can be controlled by a very simple form of controller having a single switch arm. The switch arm is adapted to be automatically returned to zero position in case of no voltage.

838,583. SYSTEM FOR CHARGING STORAGE-CELLS; Ira S. Raymer, Beaver, Pa. App. filed Aug. 23, 1905. In combination with a block-section of a railway signaling system, a track-circuit, and a signal-circuit for said block-section, three sets of storage-cells, a charging-battery and means for successively connecting the three sets of cells with the track and signal circuits and with the charging-circuit.

838,586. ELECTRIC CAR SIGN AND SIGNAL; Charles W. Ryder and Franklin Orth, Burlington, Vt. App. filed Apr. 8, 1905. A rotatable box has different compartments with colored lenses and when the box is rotated to expose a new destination of the car, a switch or commutator is automatically positioned to illuminate different lamps so as to change the color of the signal lenses.

838,605. DYNAMO-ELECTRIC MACHINE; Bernard A. Behrend, Norwood, O. App. filed Mar. 26, 1906. Relates to construction of an armature of a generator having specially arranged laminæ grouped apart for ventilating purposes.

838,623. LAMP SOCKET ADAPTER; Frederick J. Forbes and Robert E. York, Portage, Wis. App. filed June 19, 1905. An adapter for T-H sockets which has a screw accessible from the interior by which the threads are jammed so that the adapter cannot be unscrewed with the lamp.

838,647. PYRO-ELECTRIC FURNACE; Finis E. Roach, Chicago, Ill. App. filed Oct. 11, 1905. In a furnace the combination with a base of an inclosed muffle fitted upon the same and wholly closed thereby, means for heating the muffle and heat-regulating means therefor, said furnace being opened by lifting the muffle from its base.

838,652. ELECTRIC BRANDER; George J. Schneider, Detroit, Mich. App. filed July 10, 1905. A plurality of U-shaped sheet metal pieces are embossed with letters of an inscription and are arranged between insulating blocks so as to be traversed in series by an electric current to heat the same.

838,681. LIMIT SWITCH FOR ELECTRIC MOTORS; Sidney Burrowes, Falls View, Ontario, Canada. App. filed Feb. 19, 1906. Cuts off current from the motor after the latter has made a predetermined number of revolutions and includes a screw revolved by the motor and operating a nut which actuates certain stop motion devices.

838,716. ELECTROPLATING APPARATUS; William S. Hutchinson, Boston, Mass. App. filed July 29, 1905. In an apparatus for the recovery of gold from plating solutions, the combination of the rinsing-tank subdivided into a series of compartments, an inlet for rinsing fluid at one end of the series, an enriching vessel at the other end of the series, and means for supplying fresh cyanid to the rinse solution, an outlet from the said enriching vessel and a series of zinc boxes communicating with the said outlet.

838,717. PROCESS OF ELECTROPLATING; William S. Hutchinson, Boston, Mass. App. filed July 29, 1905. The method of recovering the valuable ingredients of plating solutions which consists in subjecting the freshly plated articles to successive cumulating rinsings, meanwhile causing the rinsing liquid to progress continuously in a direction reverse to the progression of the plated articles through the successive rinsings, and recovering the valuable ingredients thereafter.

838,729. WIRE TERMINAL; Fred T. Lockwood, Jackson, Mich. App. filed Oct. 26, 1905. The terminal clip for the wire is stamped of sheet metal and has a portion to surround the insulation of the wire and another portion to be soldered to the bared part of the wire.

838,742. TROLLEY CATCH; William A. Oates, Los Angeles, Cal. App. filed Apr. 5, 1904. The trolley harp is pivoted to the pole and has a detent arrangement by which a spring on the pole is effective to pull the trolley cord and retrieve the pole in case the wheel leaves the wire.

838,749. TELEPHONE SYSTEM; Henry L. Reber, St. Louis, Mo. App. filed Mar. 29, 1905. Relates to a system of connections between an A-board and a B-board for a trunking exchange system.

838,757. CONVERTING CHROMATES INTO BICHROMATES; Robert Griesheim, Frankfort-on-theMain, Germany. App. filed July 9, 1903. Details of electrolytic process making use of solutions of alkali chromate in different compartments separated by a diaphragm.

838,764. MEANS FOR INSULATING ELECTRIC CONDUCTORS; Stanislaus Berger, Trier, Germany. App. filed May 9, 1905. The circuit wires are enclosed in separate tubes which are positioned in a protecting conduit and afterward embedded in plastic material so as to be effectively separated throughout their length.

838,778. INTERIOR CONDUIT BOX; Frederick W. Erickson, New York, N. Y. App. filed Feb. 2, 1906. Details of construction of a floor box having two parts, one beneath the floor into which the conduit pipes enter, and another inset into the floor and adjustable to the level thereof.

838,780. RAILWAY SIGNAL; George P. Finnigan, Greene, N. Y. App. filed Aug. 19, 1905. Designed to exhibit a single semaphore signal at clear, caution or danger positions by a single actuating means. Has

a motor and a notched disc which is engaged by a magnet operated detent to control the positions of the arm.

838,787. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed June 8, 1901. In telephony, a connecting-plug provided with a helix, means to energize said core and means to connect the terminals of a circuit thereto, in combination with a jack comprising a stationary soft-iron plug and a movable armature attached thereto and terminals of a circuit connected to same.

838,788. ELECTRIC TRANSMISSION OF INTELLIGENCE; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 11, 1906. Means to neutralize the inducing effect of a power-wire on a series of lines of transmission, said means embracing a coil in the region of the power-wire, a coil around all the lines of transmission to be protected, the first-named coil connected to the second-named coil.

838,800. AUTOMATIC VOLTAGE REGULATOR FOR DYNAMOS; George S. Neeley, St. Louis, Mo. App. filed July 31, 1905. Relates to separately excited alternating-current generators. A shunt and a series transformer circuit energize magnets which are balanced against another magnet energized from the circuit of the exciter to cut in or out lamps from such circuit.

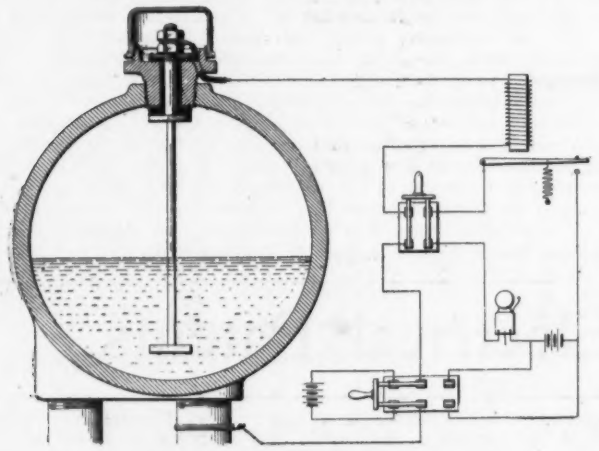
838,801. METHOD OF REGULATING THE FIELD DENSITY OF ELECTRIC GENERATORS; George S. Neeley, St. Louis, Mo. App. filed Aug. 21, 1905. Covers the method of the foregoing patent.

838,802. AUTOMATIC REGULATOR FOR DIRECT CURRENT DYNAMOS; George S. Neeley, St. Louis, Mo. App. filed Sept. 29, 1905. Relates to the regulation of direct-current dynamos employed to charge storage batteries and has two magnets in opposition to one another with a single common armature. These magnets are energized from circuits including all and only a portion of the batteries respectively.

838,809. TELEPHONE SYSTEM WITH CENTRAL BATTERY; Gottlieb M. T. Piltz, Stockholm, Sweden. App. filed Aug. 4, 1903. Relates to details of the cord circuits at the central station.

838,823. LOW WATER ALARM; William I. Thomson, Newark, N. J. App. filed Oct. 22, 1904. The water in the boiler is made use of as a conducting medium and breaks the circuit through a rod inserted therein when the level falls below a certain point.

838,811. ELECTRICAL RECEPTACLE; Bert E. Salisbury, Syracuse, N. Y. App. filed July 20, 1904. A porcelain base has a threaded



838,823.—Low Water Alarm.

shell received in a cavity and secured by screws and a central stud terminal also screwed in place. The screws are used to establish the electrical connection.

838,820. INTERLOCKING MACHINE FOR RAILWAY PURPOSES; Jacob B. Struble, Wilkinsburg, Pa. App. filed Oct. 6, 1906. The switch levers operate plungers which each have a rack to drive a magnetically damped disc. The arrangement is such that free movement of the plungers is permitted in one direction, but in the other direction their movement is damped so that a second operation is not permitted until after a certain time interval.

838,854. ELECTRIC BLOCK SIGNAL SYSTEM FOR RAILWAYS; George P. Finnigan, Greene, N. Y. App. filed Aug. 19, 1905. A complete railroad installation making use of sectional track rails energized by the batteries and contact plates between the rails for establishing alarm circuits to the locomotive. Provides means by which the signal is sometimes actuated automatically by the next succeeding signal and at other times directly by a passing train.

838,850. AUTOMATIC CALL-INDICATOR FOR TELEPHONES; Earl P. Denton and Arthur W. Nazor, Frankfort, Ky. App. filed Jan. 13, 1906. In combination with a telephone-bell and its clapper, a pointer movable by the clapper to indicate a call, a movable receiver-arm, a guide disposed at a point between the arm and pointer and a flexible element connecting the arm and pointer and arranged for travel between its ends on the guide.

838,822. BATTERY-CHARGING SYSTEM; William I. Thomson, Newark, N. J. App. filed Aug. 17, 1904. In combination, a generator, a circuit for the same comprising two paths connected in parallel, means controlled by the current in one of said paths adapted to maintain the current therein substantially constant, and means whereby upon the voltage of said generator exceeding a certain point the other of said paths is cut out.

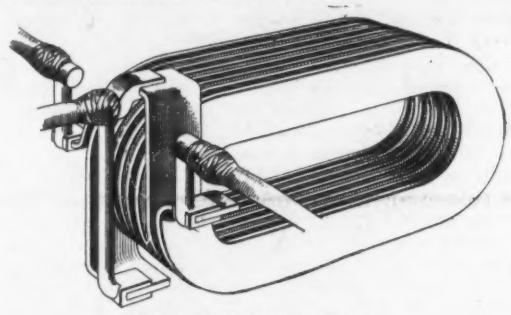
838,884. PLURAL COIL ELECTRIC HEATER; James F. McElroy, Albany, N. Y. App. filed Apr. 9, 1906. A porcelain cylinder is spirally grooved with a double thread so as to receive double spirally wound resistance elements the terminals of which are both at one end of the cylinder.

838,885. ALTERNATING CURRENT HEATER; James F. McElroy, Albany, N. Y. App. filed Sept. 6, 1906. A system of heating coils adapted for three-phase circuits. The arrangement is such that all or a portion of the coils may be used, but their action is balanced under all circumstances.

838,886. OUTLET BOX; Michael J. McGowan, Jr., Newark, N. J. App. filed Dec. 14, 1905. A cast-iron outlet box having a plurality of divergent openings to receive the circuit wires, each of said openings projecting diagonally into the box and having a set screw to secure the circuit wires.

838,916. INDUCTIVE BOND; Louis H. Thullen, Edgewood, Pa. App. filed Feb. 27, 1906. The bond is made of a spirally wound copper band enclosed by an ordinary transformer core. The band has a central terminal and is so connected to the track circuit that the direct current flow neutralizes the magnetization of the core and does not completely saturate it so as to destroy its efficiency as an inductance to the alternating current.

838,949. VAPOR RECTIFIER; Alexander Churchward, New York, N. Y. App. filed Apr. 19, 1905. In order to operate mercury vapor rectifiers on low potential circuit such as charging small storage batteries, the patentee has inductance windings which allow the full voltage to the rectifier at starting, but afterward automatically cut down the voltage as soon as the current begins to flow.



838,916.—Inductive Bond.

838,950. THERAPEUTIC LAMP; Harley E. Coger, Minneapolis, Minn., and John B. Marshall, Chicago, Ill. App. filed Aug. 31, 1905. A sheet metal casing of double conical form encloses a lamp and has an orifice through which the rays may be directed against any desired point.

838,977. SOLUTION FOR USE IN ART OF ELECTROTYPING; August Gerstner, New York, N. Y. App. filed Apr. 20, 1906. A solution for use in the art of electrotyping comprising nitrate of silver, chlorid of sodium and graphite.

839,000. VIBRATOR; Edward B. Jacobson, Pittsfield, Mass. App. filed Dec. 19, 1905. Details of an induction coil vibrator having a screw by which its position is adjusted independently of the adjustment of the vibrator contacts. Has a main spring with a contact point on the main spring projecting freely through an aperture in the armature.

839,023. INCANDESCENT ELECTRIC LAMP; George A. Nellis, Allegheny, Pa. App. filed Sept. 25, 1905. In order to avoid the use of platinum leads for an incandescent lamp, the patentee makes use of small copper helical coils which are cemented into conical passages of the glass by a special cement which is stated to produce a perfect seal.

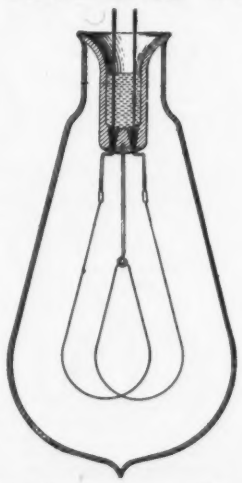
839,029. RECEIVING SYSTEM FOR WIRELESS TRANSMISSION OF SIGNALS; Valdemar Poulsen, Copenhagen, Denmark. App. filed Oct. 2, 1905. In a receiving system for wireless transmission of signals, a condenser arranged to be charged by the received wireless impulses, and a local source of power connected to said condenser to change the capacity thereof, whereby the energy of the electric charge is multiplied.

ORDINARY TELEPHONES; Kelly M. Turner, New York, N. Y. App. filed Apr. 9, 1906. An arrangement to permit deaf persons to talk at an ordinary telephone with perfect ease. The patentee makes use of an acousticon transmitter of the form ordinarily sold and used on the market and into which the telephonic conversation is received from the usual Bell receiver. The acousticon transmitter is in a special battery circuit with a small receiver which is adapted to be placed against the ear in use.

839,048. AUTOMATIC CUT-OUT DEVICE FOR ELECTRIC CIRCUITS; William O. Taylor, Limerick Square, Pa. App. filed Jan. 3, 1905. In order to cut out a spark coil of a gas lighting circuit immediately after it is used, the coil is provided with two armatures which have spring blades to impel the operating button back to its normal position after the armatures have been attracted.

839,072. RAIL BOND; Frank D. Masterson, Boston, Mass. App. filed Oct. 2, 1905. In order to prevent the layers of a rail bond from separating under the motions of the rails, the patentee has a strap or tie band surrounding the layers which permits their free movement to preclude their separation.

839,079. TIME LIMIT CIRCUIT BREAKER; William M. Scott, Philadelphia, Pa. App. filed Feb. 17, 1903. A complete mechanical con-



839,023.—Incandescent Electric Lamp.

struction of a circuit breaker having a chamber which encloses mercury and which can be weighted differently so as to tilt after a greater or less time interval. The circuit is not opened until this chamber tilts.

12,581. ELECTROMAGNETIC FRICTION CLUTCH; Wenzel Schuster and Reinrich Ast, Vienna, Austria-Hungary. App. filed Nov. 22, 1906. A form of magnetic clutch having a magnet winding inset in an annular recess in an iron disc. The armature is also in the form of a disc mounted to rotate concentrically therewith. The discs each have friction rings opposite the coil which are of non-magnetic metal and always insure an air gap between the iron surfaces.

5224

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I-T-E

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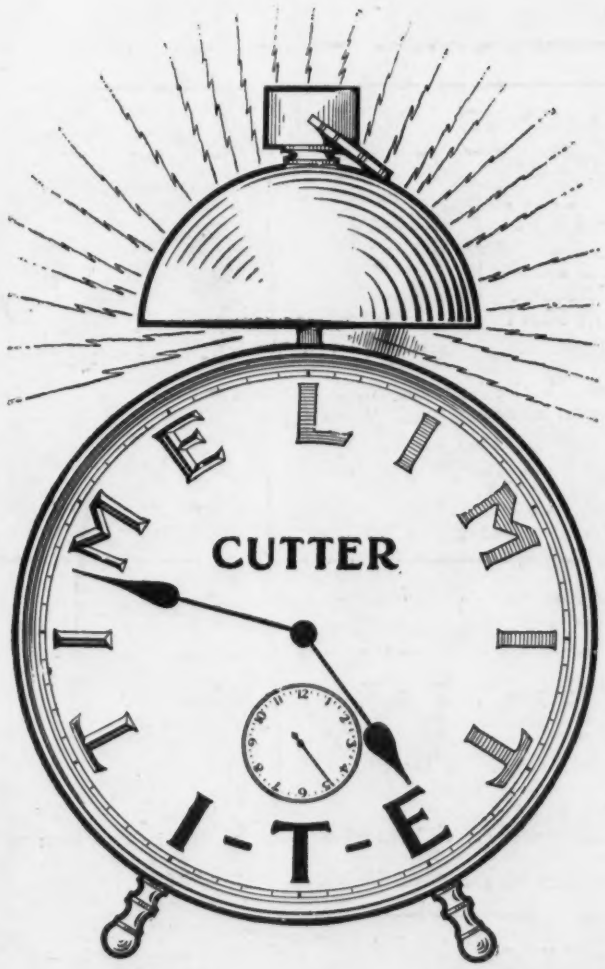

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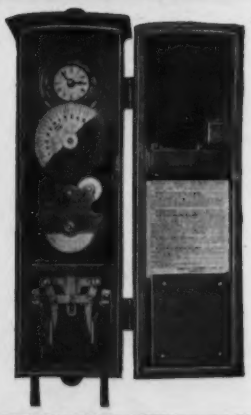

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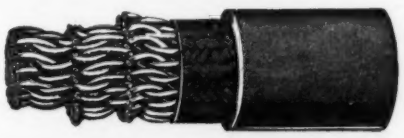

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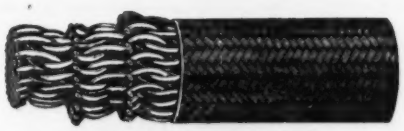

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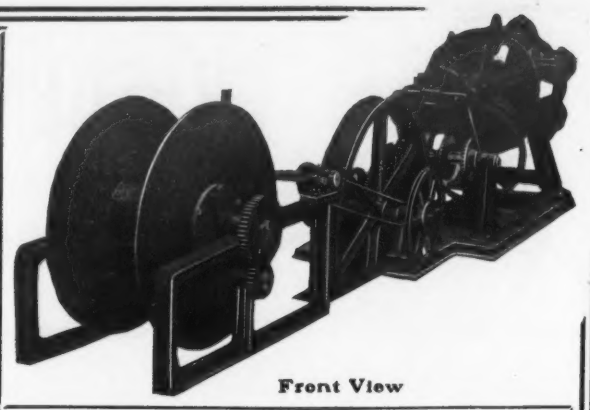
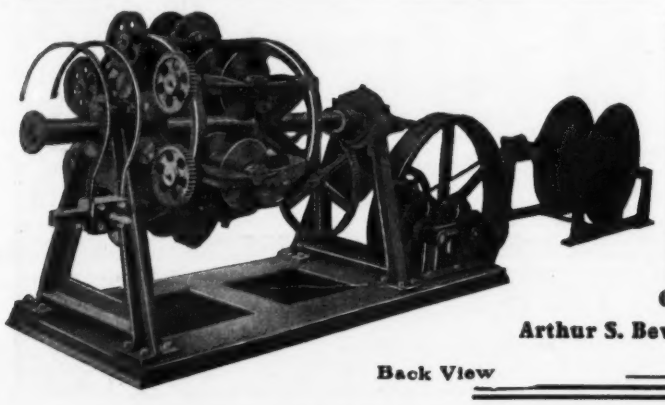


Front View



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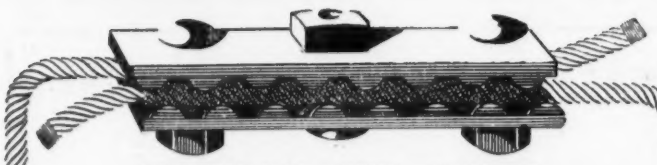

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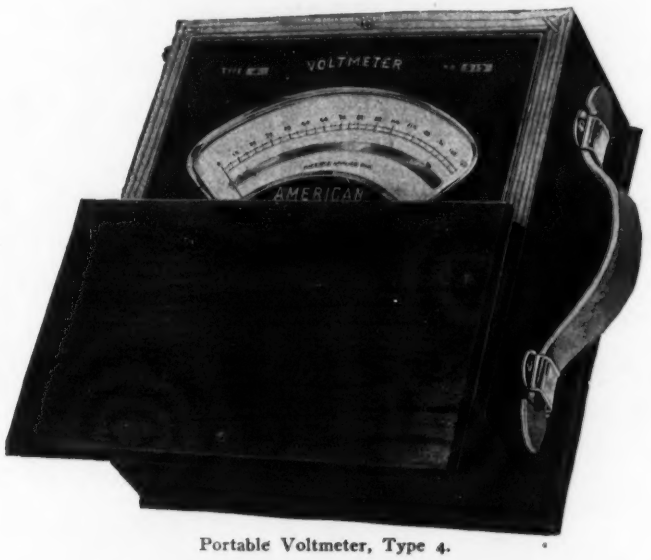

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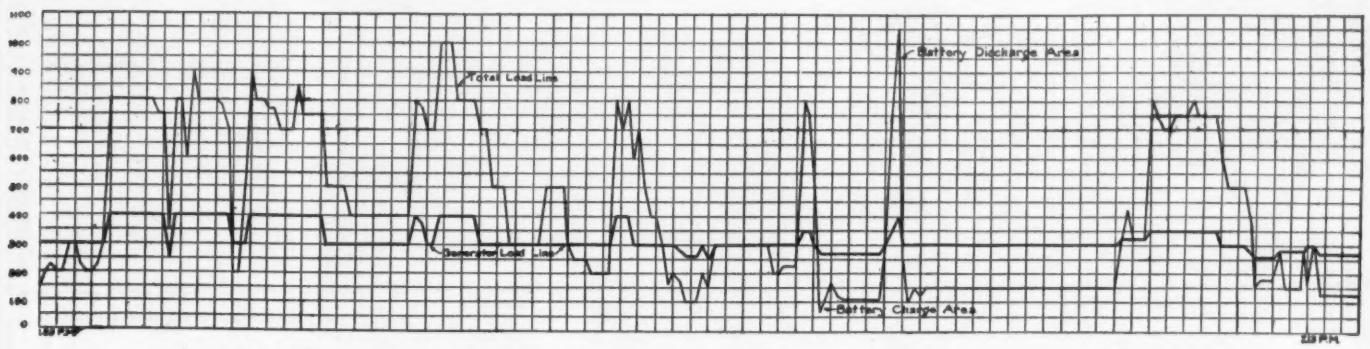

Load Diagram Showing Operation of a Battery of Chloride Accumulators in Regulating Fluctuations at a Railway Power House

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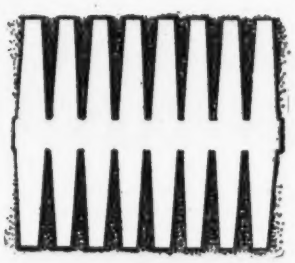

The Gould Plate, in process of manufacture, is given a closely-ribbed surface and in the grooves, or spaces between the ribs, the active material is formed electro-chemically, as shown in the diagram. The structure of these elements is highly porous though densely packed in spaces so narrow as to render mechanical dislodgement nearly impossible.

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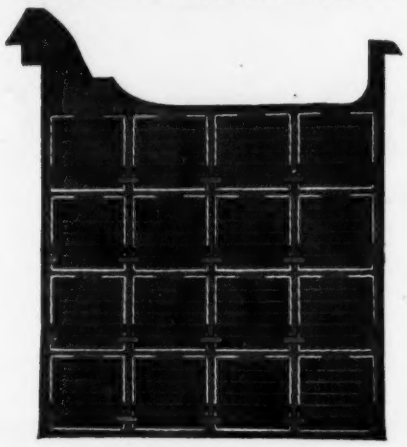

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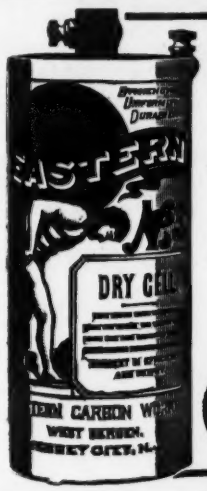

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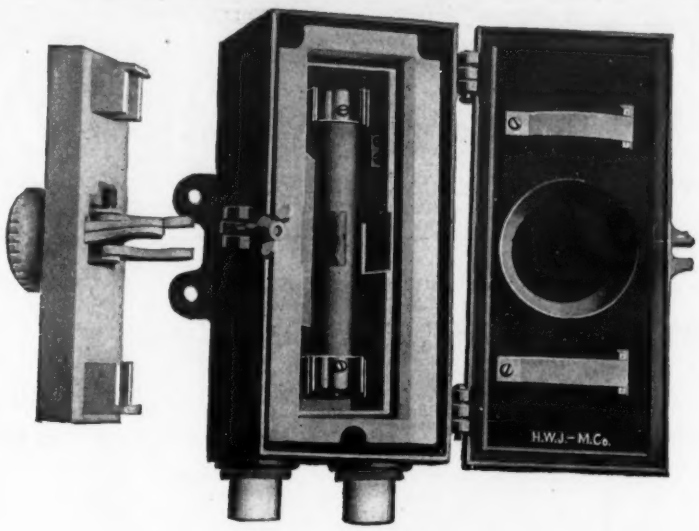

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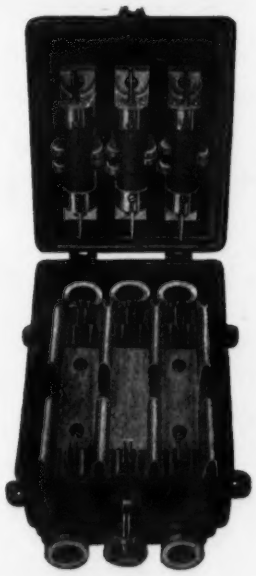

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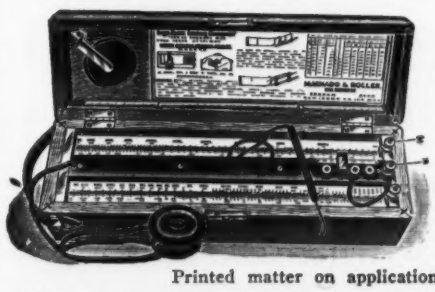

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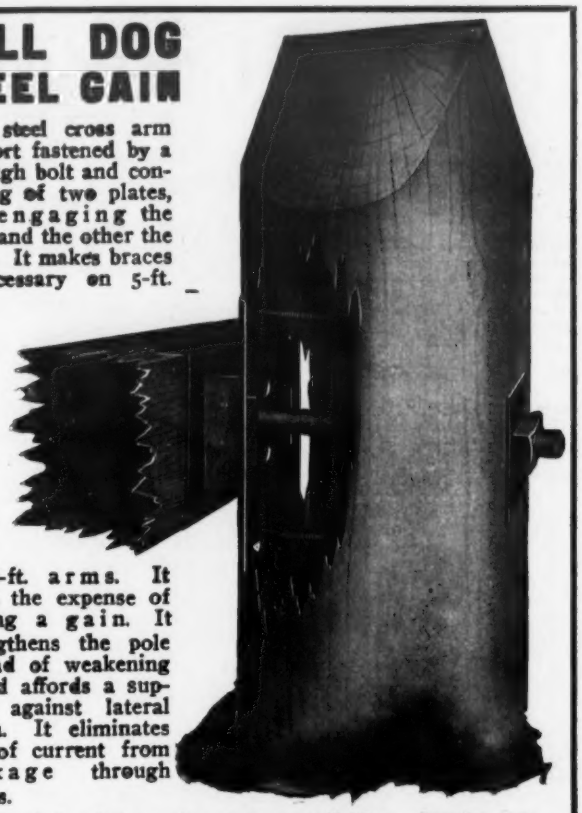

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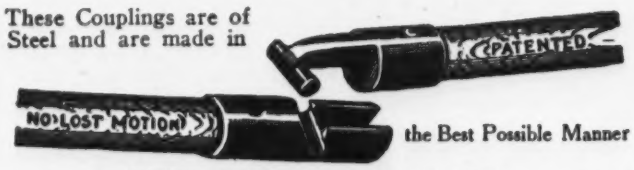

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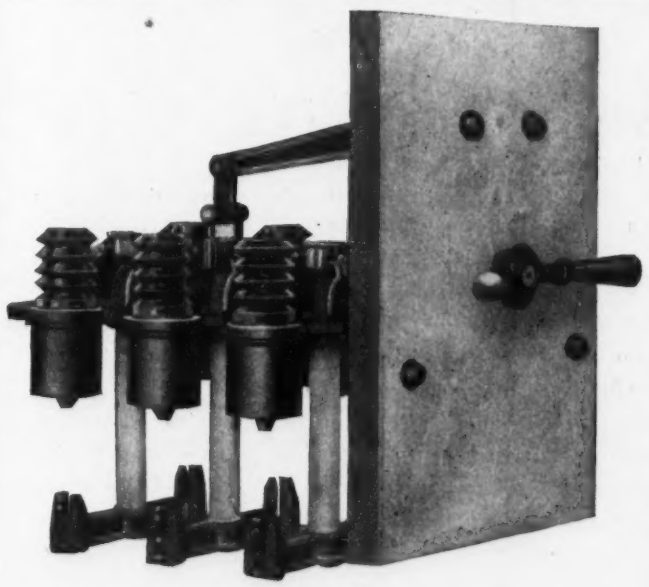

The cut shows our 15,000-volt, type C, non-automatic oil switch, with oil tanks removed. The tank-covers and corrugated bushings are made of moulded, indurated fibre, a material which will stand 23,000 volts per ⅛ in. without breaking down. The oil tanks are made of the same material.

The live parts of the switch are thus completely surrounded by a barrier of insulating material, and there is no possibility of current leaking to the operating mechanism or metal supporting frame.

Send for our bulletins Nos. 6 and 7.

Hartman Circuit Breaker Co.
MANSFIELD, OHIO

I-T-E Circuit Breakers

TYPE "W"

For Motor Protection

500 Volts and Under

Made in single, double and triple pole. Plain Overload, Overload and "No Voltage," and "Overload and Limit."

TYPE "W" Circuit Breakers are simple and strong in construction and are not intended for remounting. They are furnished only on black enamel slate bases, from which they should not be removed.

The finish is black and polished copper. Thoroughly durable and in keeping with the service for which the apparatus is intended.

The circuit breaker is provided with back connections, which, when it is desired to mount the instrument against the wall, may readily be made accessible by supporting it upon suitable cleats. Write for bulletin on Motor Types.

THE CUTTER CO.

Factory and Office: **Philadelphia**

W. C. Jessup, 120 Liberty Street, New York City.
H. B. Otis, 636 Marquette Building, Chicago, Ill.
H. W. MacVaugh, 1406 Machesney Building, Pittsburg.
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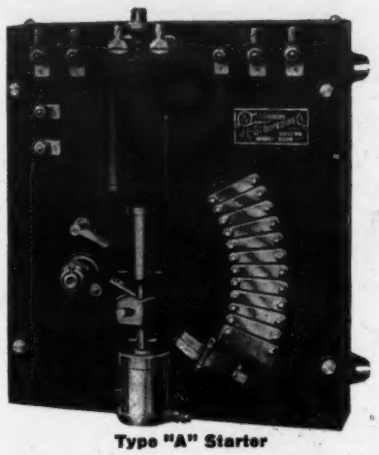
The I-T-E Elec. Co., Ltd.

20 Great Russell Street **London, Eng.**

AUTOMATIC PUMP STARTERS



Type "A" Starter

The bottom segment on this starter is made of insulating material. By means of a "lost motion" arrangement in the vacuum dash-pot, the contact arm jumps to the first copper segment as soon as the solenoid is energized. As the circuit is thus made and broken postively, no additional solenoid or magnet switch is required. Prices on request.

J. L. SCHUREMAN CO.,

MANUFACTURERS OF
Automatic Motor-Controlling Devices
Pump Starters Elevator Controllers Distant-Control Switches
European Agents:
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Wirt Dimmers for Hard Usage:

Stand very heavy overloads. Practically fire proof. No small parts. Extreme durability. Continuous ribbon resistance. Graded steps. See catalog.

The Wirt Electric Co.
Philadelphia, Pa.

FIG 61

CRESCENT PANEL BOARDS

and **SWITCHBOARDS** comply with underwriter's requirements

CRESCENT ELECTRICAL MFG. CO.
187 N. Water St., Rochester, N. Y.

KRANTZ

On the name plate of a switchboard or panel board means satisfaction for the
Contractor, Architect, Owner and Operator

L. KRANTZ MANUFACTURING CO.
160-166 Seventh Street **BROOKLYN, N. Y.**

Automatic Starters

FOR D. C. OR A. C. CIRCUITS

No Sliding Contacts

Write for our catalog.

SUNDH ELECTRIC CO.,

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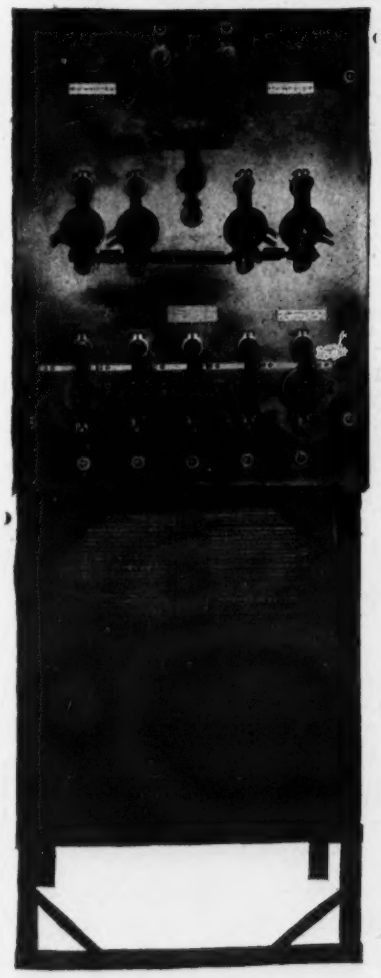

OUR MOTOR Controllers

HAVE

NO

Solenoids, Rubbing Contacts, Dash Pots, Suction Air Pots, Cams, Gears, Belts, Compression Cylinders, RetardingSprings

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New York Electric ControllerCo.

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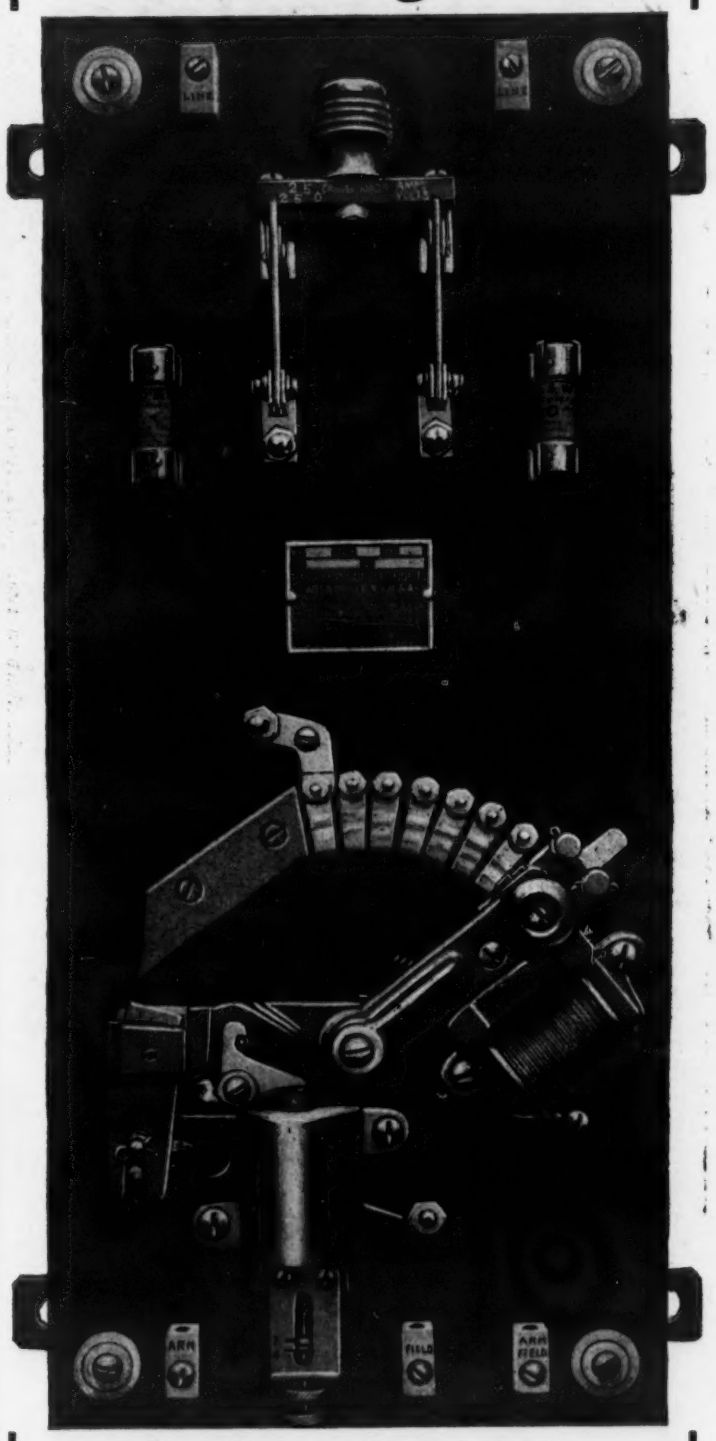
Ward Leonard Motor Controlling Panel



Investigate our latest features

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Typical price this panel,
3 H. P., 110 volt—$25 list

Ward Leonard Electric Company

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Switchboards
Panels
Knife Switches
and
Electrical
Power Appliances

Write for Quotation.

THE F. A. LA ROCHE COMPANY,

652-664 Hudson Street,

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That Trumbulls are specialists in switch manufacturing is shown in the general favor with which their goods are received and the promptness of their deliveries.

The **CARLOAD** of **KNIFE SWITCHES** shown in the cut was shipped in three weeks after receipt of the order, and the routine of general business was not disturbed.

We carry a larger stock of Knife Switch material than any other manufacturer in the country.

We can therefore give quicker service. Don't hesitate to send your largest orders.

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NEW YORK OFFICE: 136 LIBERTY STREET

Springs
Of All Kinds

Steel Springs
Motor Springs
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All Good Springs

well made and economical in price. Try them.

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Estab. 1875

We make these and dozens of other composition devices

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And we do our work RIGHT

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Campbell Time Switches

Will net you big profits
Will satisfy your customers
What more do you want?

Campbell Thermo Flashers, $1—best out.

Campbell X-Ray and High-Frequency Apparatus.

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CAMPBELL ELECTRIC CO.

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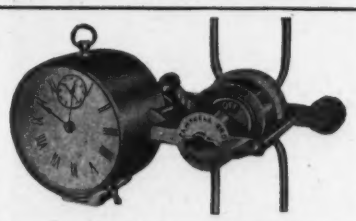

Cary Spring Works

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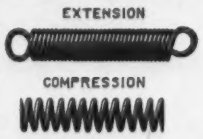
NEW YORK CITY.



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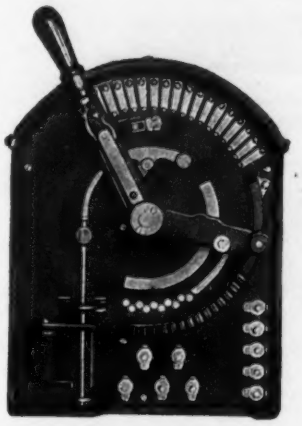
Manufacturers of Wire and Springs of all Kinds

WHEN YOU SPECIFY CONTROLLERS FOR PRINTING PRESS MOTORS



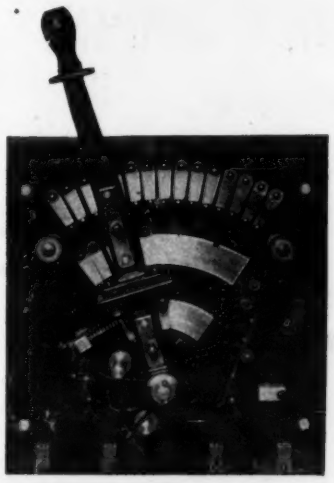
Remember that there is a C-H Controller for every style and size of press

Carpenter Type Controllers.—

SIMPLE AND SELF-CONTAINED. OPERATED BY ONE LEVER.

Built in sizes from one-half to fifteen horsepower.
Ten different types, provided with Carpenter enclosed resistances.
Supplied reversible or non-reversible, with underload or overload release, or both, as conditions require.
Dynamic Brake where necessary.

BULLETINS 81 to 89½

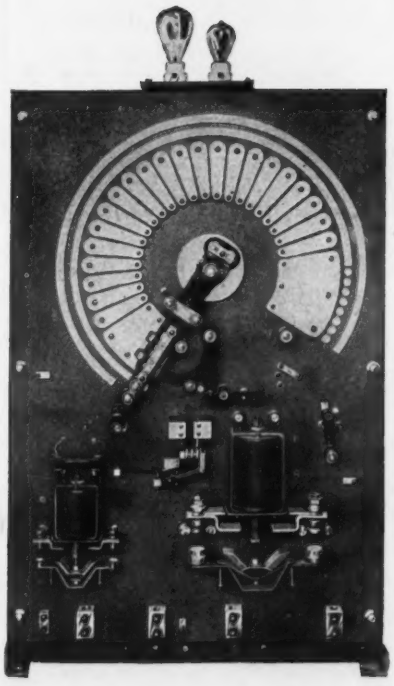


Controllers For Small Job Presses.—

SIMPLE AND SELF-CONTAINED. OPERATED BY ONE LEVER.

Built with two reverse speeds and automatic release.
Will reduce speed of motor from normal to one-half normal.
Renewable copper segments which may be easily replaced at insignificant cost.

BULLETINS 62 and 64



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Quick-acting independent switch for quick stops.
Positive control of press cylinders.
Slow, steady speed obtainable for "threading in" paper.
Several printing speeds available for different classes of work.
Overload, underload release, and dynamic brake features.

BULLETIN 68

The Cutler-Hammer Mfg. Co.

MILWAUKEE

New York Boston Chicago Pittsburgh

A Big Difference

can be seen if in one case you've used cast iron boxes, while in the other

BOSSERT DRAWN STEEL BOXES

The work of drilling, filing and reaming of cast iron boxes, in order to make the holes, is a long task, while to make a clean, round hole in a **Bossert Box** is the work of but a second—give the hermetically sealed plugs a sharp blow and out they come, leaving a clean, round hole; aside from this, any strain, or the settling of buildings will only bend **Bossert Boxes**, while it would break a cast iron box.

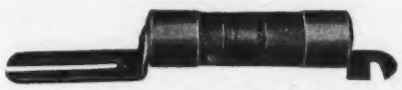
Aren't these points worth your consideration?

The Bossert Electric Construction Co.

Utica, N. Y.

"SHAWMUT"

EXTENDED TERMINAL FUSES



PAT. NOV. 6, '06

FIT ANY TYPE "A" or SCREW CLAMP BASES

Write for Bulletin No. 36 and Sample

CHASE-SHAWMUT COMPANY

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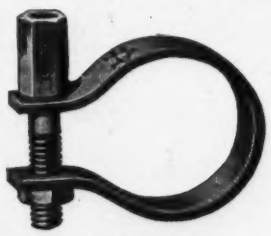
If you will send for a sample of the G. V. GROUNG CLAMP



TRY ONE
IT WON'T COST YOU ANYTHING

we know it will benefit us both eventually. We use no iron to rust, and it can be readily taken off years afterward.

List Prices

For	½-inch	pipe	$.24
"	¾	"	.29
"	1	"	.34
"	1¼	"	.40
"	1½	"	.46
"	2	"	.52
"	2½	"	.59
"	3	"	.84

Standard Package Quantities

½-inch	and	¾-inch			100
1	"	"	1¼	"	75
1½	"	"	2	"	50
2½	"	"	3	"	25

Write us for Discounts

Manufactured by

THE GILLETTE-VIBBER CO., New London, Conn.

The G. V. Pipe Cap

for electric wires

Try Them

We make them and will send you sample free.

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Baltimore: C. A. Brown; Office, 11 E. Lexington St.

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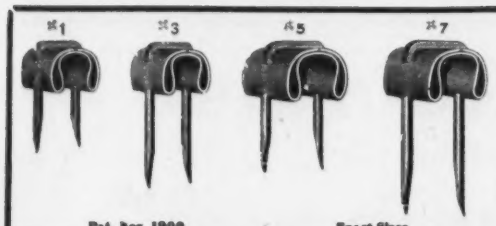

Pat. Nov. 1900 Exact Sizes

Blake Insulated Staples

Blake Compressed Cleats

Manufactured and for sale by

Blake Signal & Mfg. Co.

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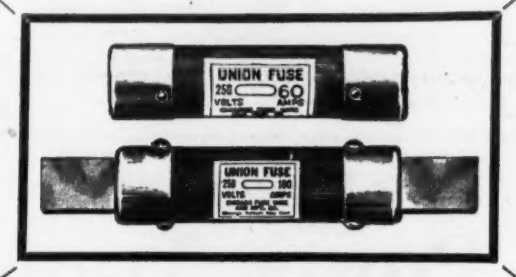
Exact Size Pat. July, 1906

"UNION" ENCLOSED FUSES

ACCURATE — RELIABLE

Approved and Listed by the Underwriters' Laboratory Chicago

SPECIFY **"UNION"** on your next Order



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NO EXCESSIVE HEATING on full load — **EFFICIENT**

SURE OPERATION on overload — **INDICATING**

NO QUESTION

but what your system is perfectly protected when the fuses in use are

"UNION"

PERFECT OPERATION

Chicago Fuse Wire and Mfg. Co., CHICAGO and NEW YORK

ANOTHER BULL'S EYE FOR "D & W"

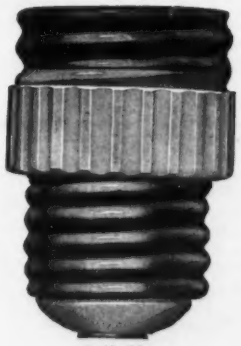
TYPE C INDICATING PLUG FUSE

3-30 AMPERES, 250 VOLTS

NATIONAL ELECTRICAL CODE STANDARD

Before Blowing

Blown Fuse Located Immediately



Full Size

Testing Circuits Eliminated

After Blowing

Renewable at Factory. Write for our latest publication "W" on Fuse Construction.

D & W FUSE COMPANY, Providence, R. I.

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The new, fourth edition of Dr. Bell's book has been revised throughout, and has received many substantial additions, rendering it an authority on the subject of high-tension power transmission

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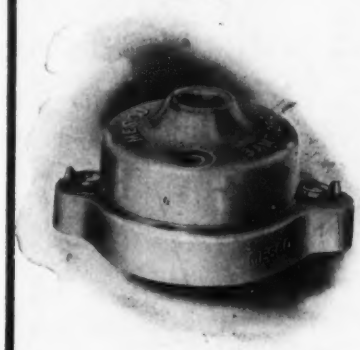

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We Manufacture a Complete Line of Pony, Standard Size, and K. & W. Rosettes

Interchangeable Separable Cap Fittings

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Illustrations show the large field of usefulness in our Separable Cap Fittings.

Caps being Interchangeable make it possible to transfer portable lights, heaters, Irons, fans etc., from one of these fittings to another without rewiring.

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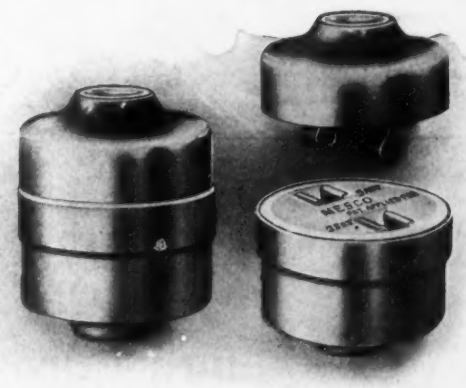
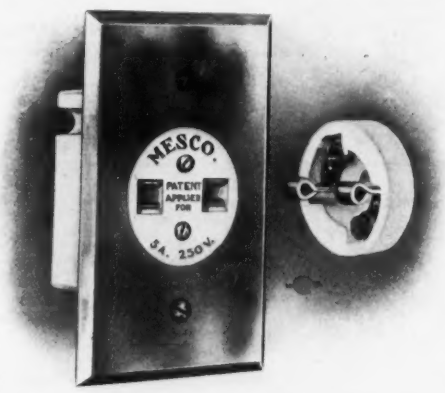


Mesco Stage Connector. List No. 16412.



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When you order
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P & S Sockets are lubricated with a non-conductive lubricant. They operate smoothly all the time.

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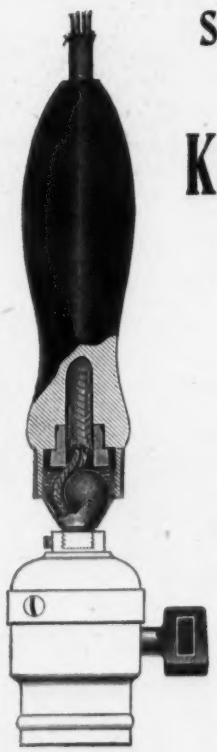

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THE

Keough Cord Grip Socket Handle

is an absolute necessity where high class installation is required. Impossible for cord to pull out. Takes largest size reinforced cord with ⅛ inch socket.

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Send your orders to us for prompt shipment.

We make only one grade of material THE BEST.

Our BRASS CAP ATTACHMENT PLUG has superior features over any on the market. Send for Sample PRICE, $.08.

Write us for our Special offer on Cut-outs, Receptacles, Fuse Plugs, W. P. Sockets, etc. We are certain our plan and prices will interest you,

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Convincing Arguments

ON THE

PENDANT SWITCH

(SARCO)

CUT FULL SIZE

The only one with the

OCTAGON SHAPE

JOBBERS like it—
Only one style to carry in stock and an easy seller

CONTRACTORS like it—
Easy to connect.
No come-backs.

USERS like it—
It's good looking and always works.

SEND FOR BULLETIN AND DISCOUNTS.

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906 SIXTH AVENUE,

New York City.

ELECTRICAL SARCO SPECIALTIES

COMPARISONS ARE ODIOUS

BUT

THE HOLDFAST LAMP GUARD

will come out victorious and without odium if comparative tests are made with it and any "guard."

HOW TO MAKE A GOOD TEST

Send for samples of all lamp "guards" offered for sale. Get some burned out lamps. Rig up a drop cord within 3 feet of a solid hard wall. After you have attached the "guard" to the drop light according to directions of the manufacturer, take hold of the "guard," draw it back and slam it against the wall with force.

This test will prove to you beyond a doubt which "guard" is a guard to your lamps. The only one of the many offered that will save the lamp under these severe conditions, and therefore under all conditions, will be

THE HOLDFAST LAMP GUARD

Your decision will be the same as hundreds of others. You will order HOLD FAST LAMP GUARDS

BECAUSE

they protect the lamp and filament always. They are easily and rigidly attached to the socket. By breaking the thread on the set screw, they can be locked to the socket securely against loss. They do not have to be removed to get at or replace the lamps. The downward rays of light are not obstructed. They are recommended by all insurance companies. They eliminate the possibility of fires from lamps. You can use any standard shade with them.

SEND FOR A SAMPLE TO TEST

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227 N. SECOND STREET ST. LOUIS

MONEY SAVERS

THE PROBLEM SOLVED

ANY
LAMP GUARD
That through improper fastening can come in contact with the lamp is a
FAILURE
That is one reason why the
HUBBELL LAMP GUARD
IS A SUCCESS. IT CAN'T TOUCH THE LAMP

THE RIGIDITY IS HERE
Close to the Neck of the Lamp
A fastening that gives strength to the entire guard, doing away with screws and clamps.

LITTLE OBSTRUCTION TO THE LIGHT.
No support for bulb.
Guard cannot touch the lamp.

AMPLE SPACE TO INSERT LAMP

HUBBELL No. 5485

Compare this guard with any other make. Note small amount of wire, little obstruction to light, quick and rigid fastening to socket without the use of screws and clamps, and the inability of the lamp to come in contact with guard, thereby prolonging the life of the lamp. Free sample sent on request.

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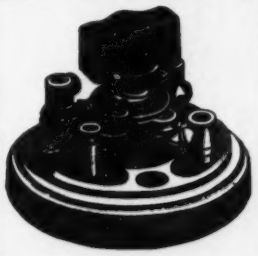

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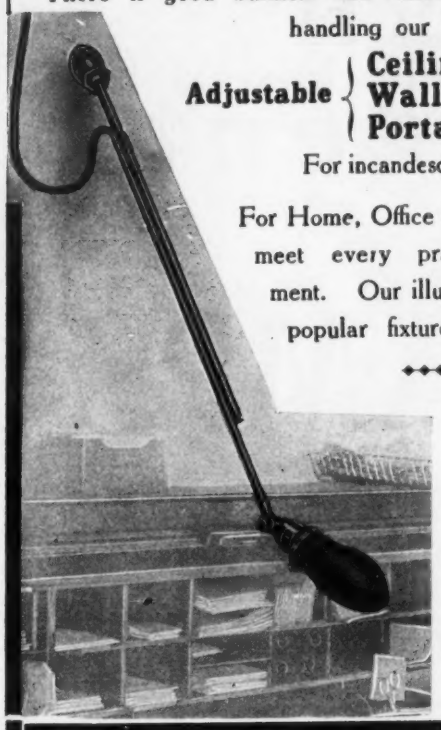

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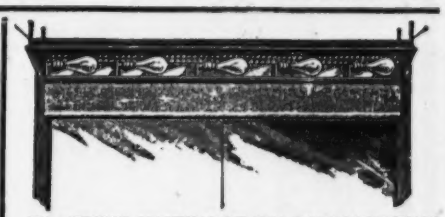

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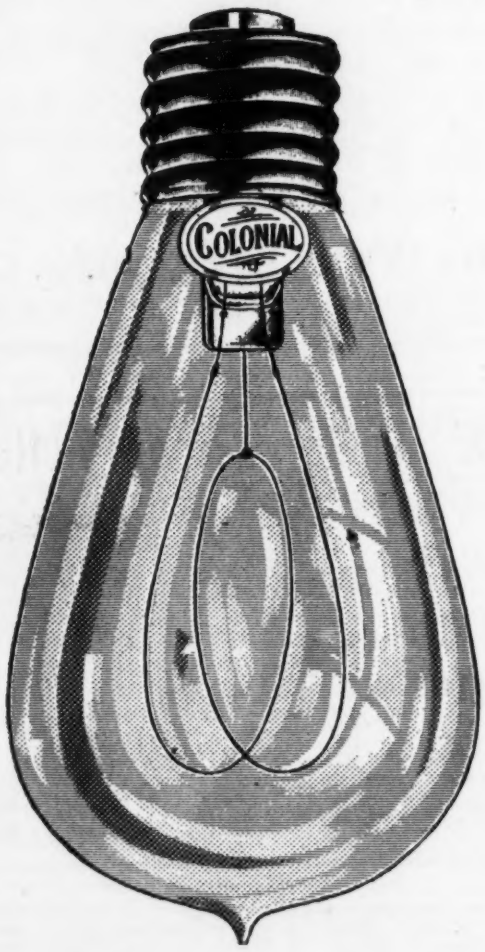

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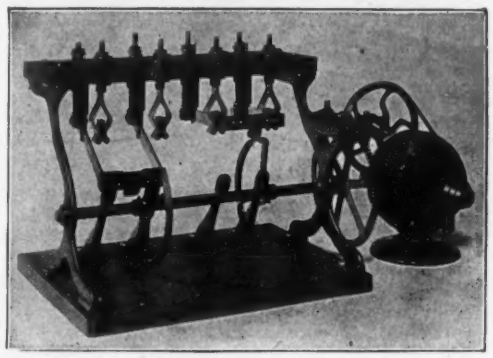

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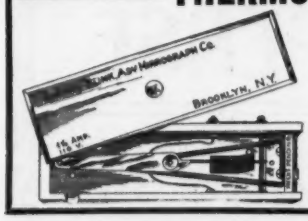

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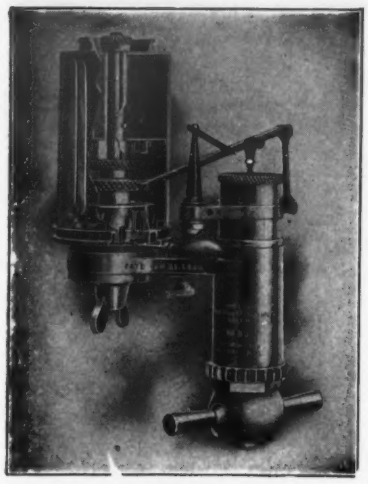

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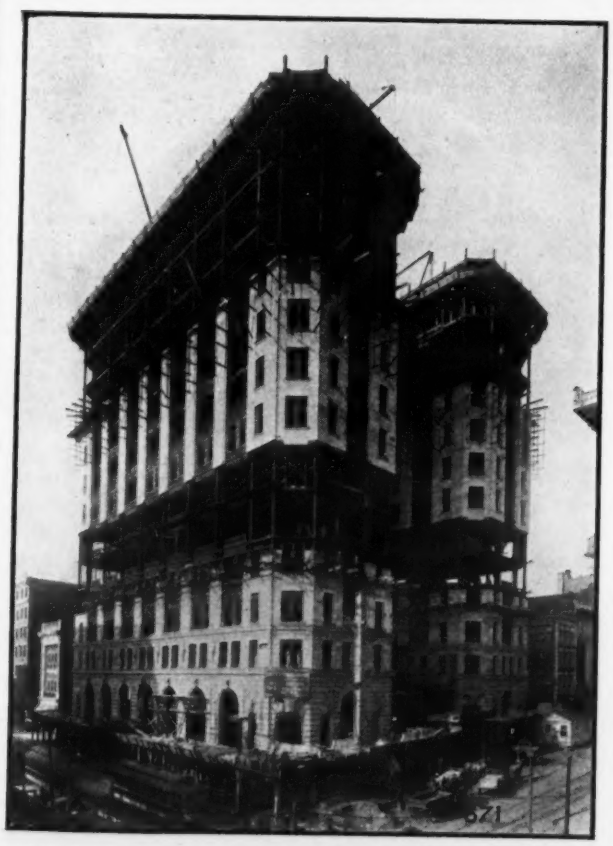

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(*Continued on page 64.*)

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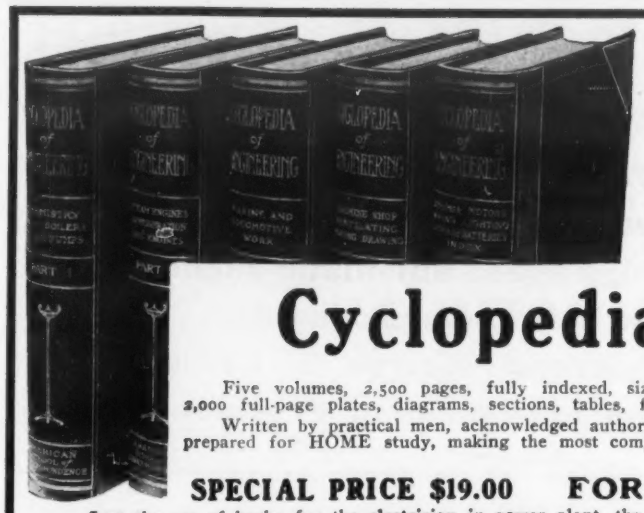

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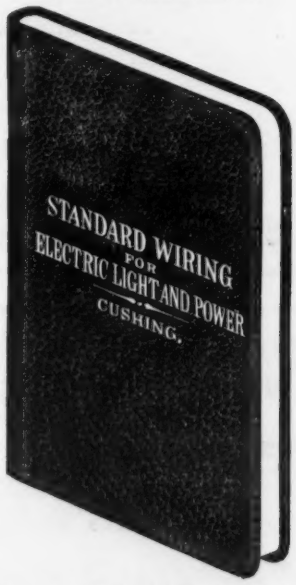

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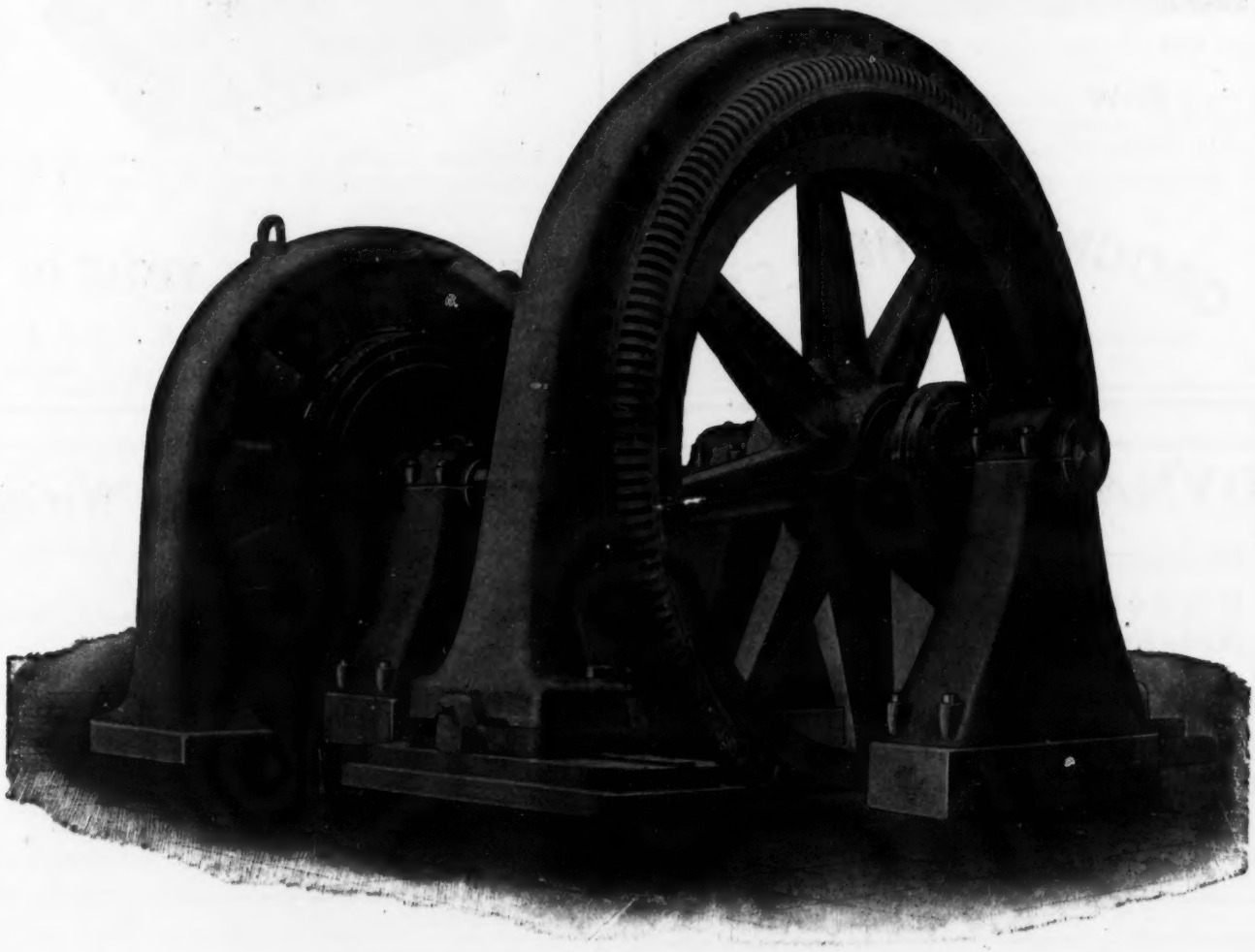

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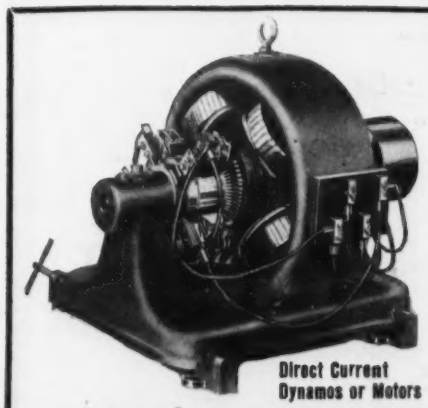

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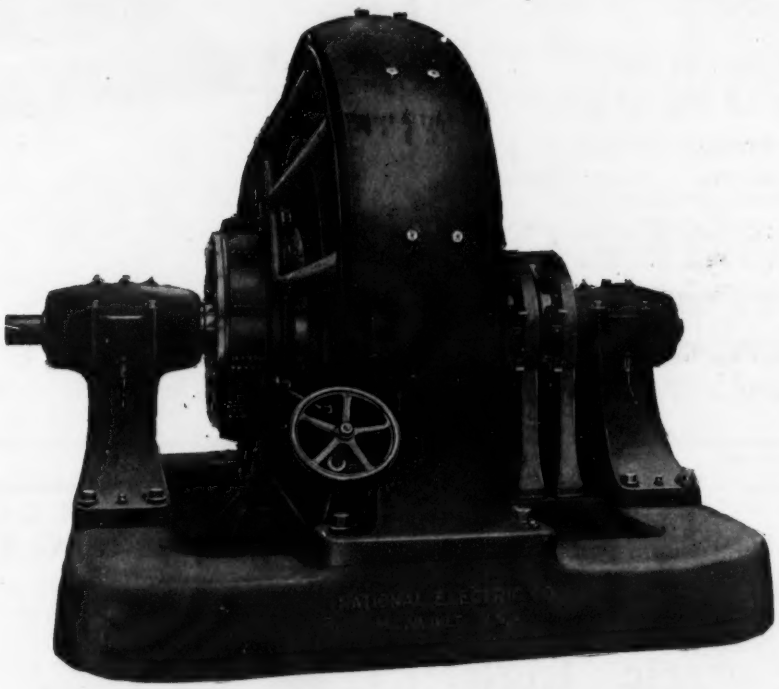

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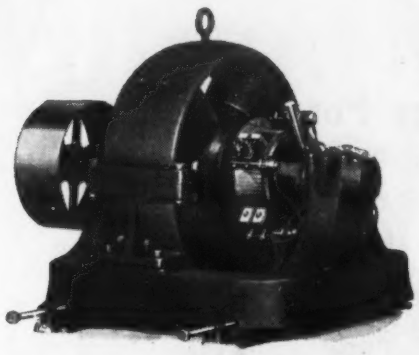

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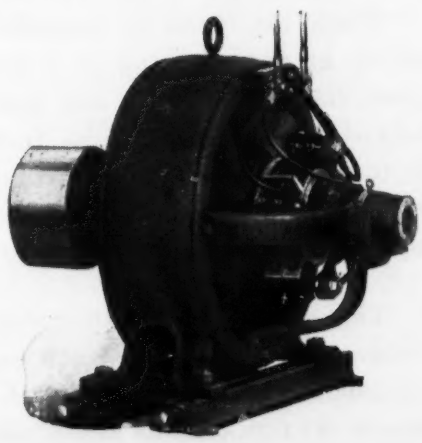

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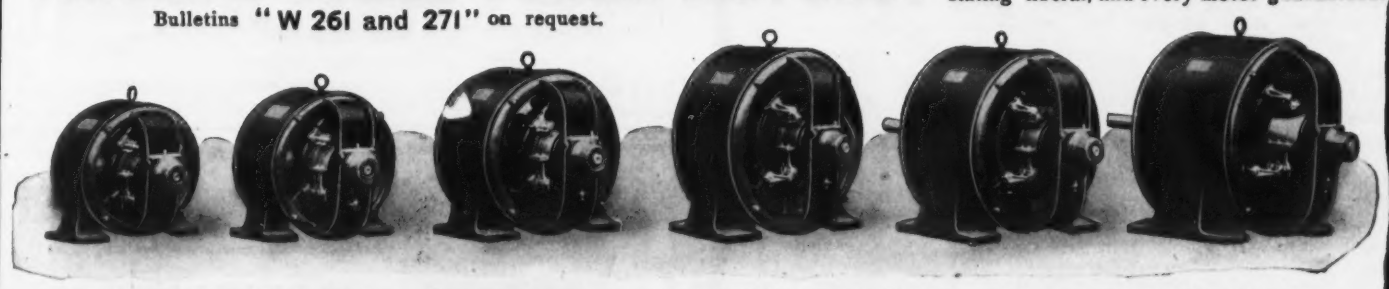

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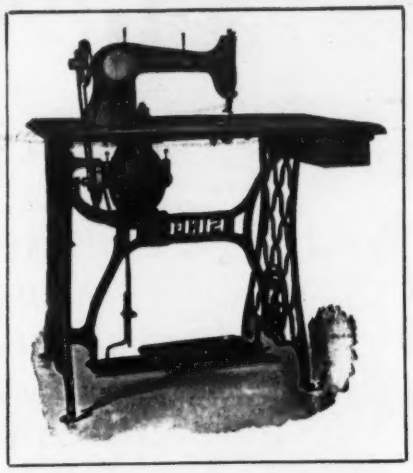

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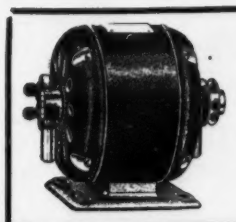

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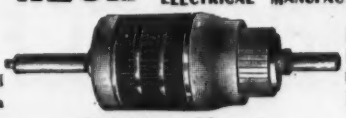

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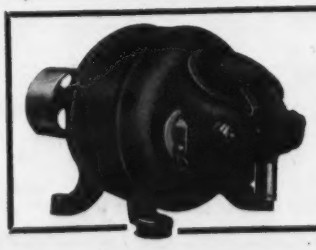

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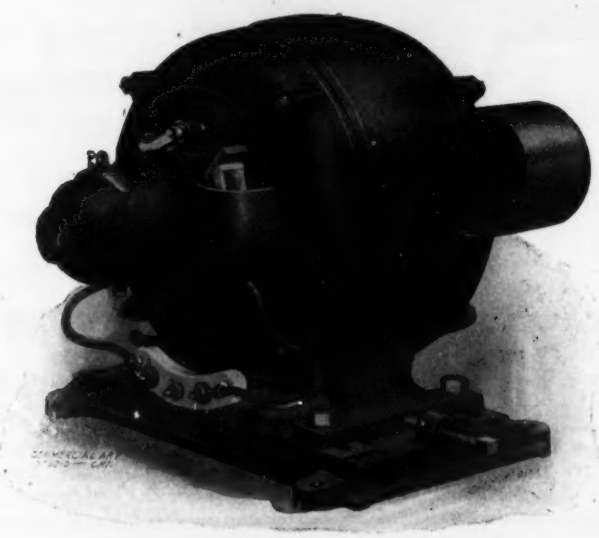

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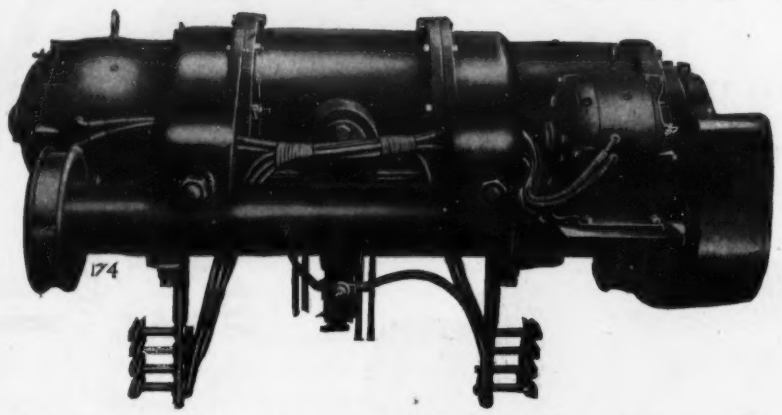

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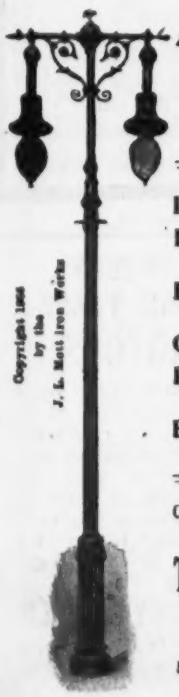

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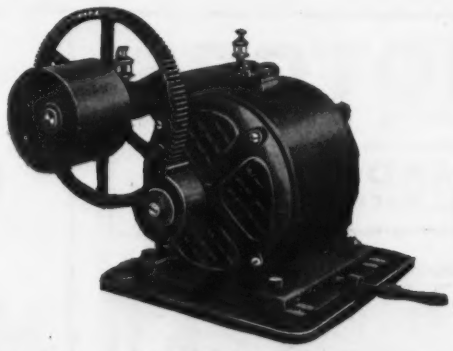

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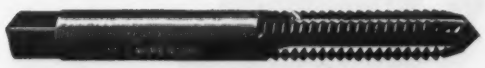

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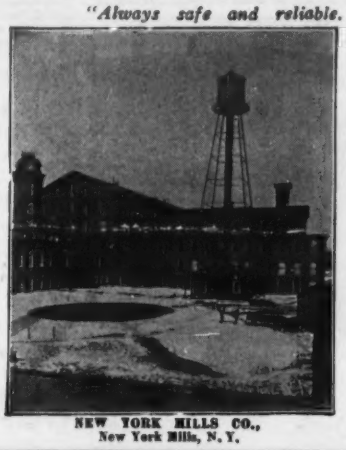

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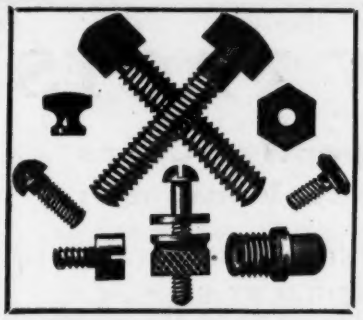

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of making these little things that is bound to appeal to you if you will permit us to tell about it. We do it so cheaply that you will be surprised when you see our estimate. Write us.

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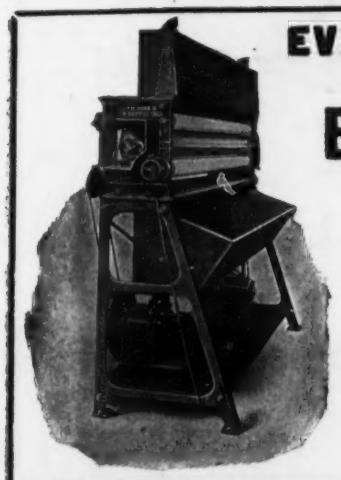

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Easy to operate, compact, self-contained, noiseless, small amount of current, perfect contact, uniform tone, variable speed, economical.

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It will increase the transmitting capacity of your belts.
Your belts will run easy or slack.
It will increase your power and decrease your friction load.
It is a preservative filler for belts—not sticky.

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3 times the pull of a wood or pulp pulley.
$2\frac{1}{2}$ times the pull of iron pulleys.
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Non-Breakable.

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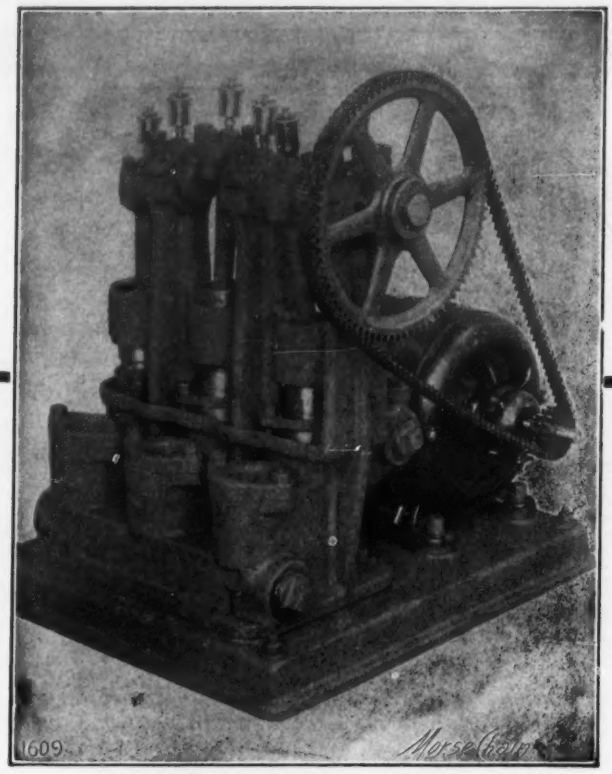

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Silent Running
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Permits an unbroken contact the whole width of the chain, thus doubling the length of bearing surface in a chain of given width. In other chains, built up of alternate links, one set of links must carry the pressure of the pin in each direction, leaving but one-half the length of the pin for bearing surface.

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Hoisting and Conveying Apparatus

Overhead Tramrail and Trolleys for Shop Use

Indispensable for the safe and convenient handling of heavy weights indoors.

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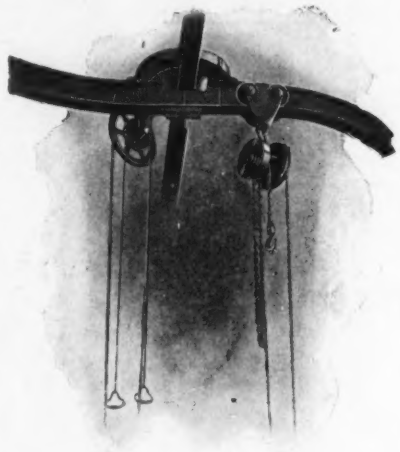
Overhead Tramrail and Trolleys,



adapted for every description of overhead support and with complete system of curves, single and double switches, turntables, etc.

Trolleys equipped with Triplex Pulley Blocks, with hand or electric power hoisting and traveling gear.

Made to carry any load and adapted to any location.
We furnish complete systems, ready for installation.

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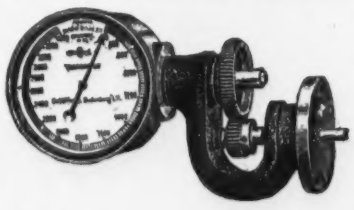
FOR HIGH SPEED



This instrument employs a rawhide gear which works smoothly and is perfectly noiseless. It is particularly good for direct attachment to high-speed engines, turbines, etc.

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Two cast-steel rings are carried on web plates bolted to the ends of the shaft.

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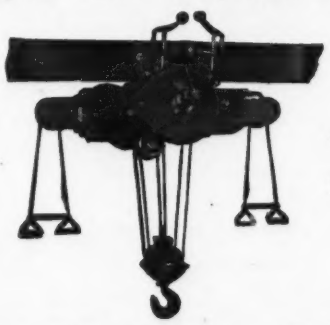

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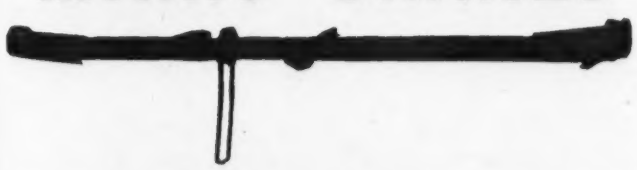

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Twenty Yale & Towne TRIPLEX BLOCKS in one plant have each lifted about 216 miles in six years. They are still in excellent condition.

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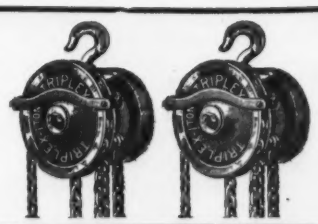

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Hunt Noiseless Gravity Bucket Conveyor, which carries the material in any direction, without shock, breakage or violence, and every bearing arranged to be kept thoroughly lubricated, and the whole machine as durable as an ordinary machine tool. We shall be pleased to send our catalogue on request.

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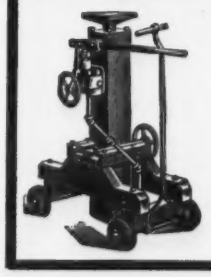

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which combines
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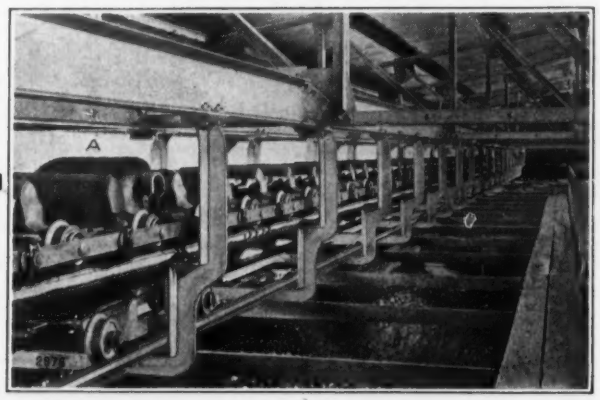

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are designed to suit conditions—space, material and so forth.

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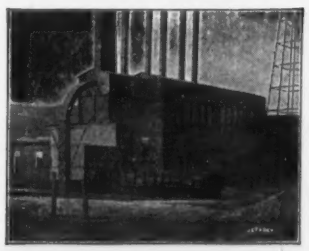

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The Stirling Consolidated Boiler Company

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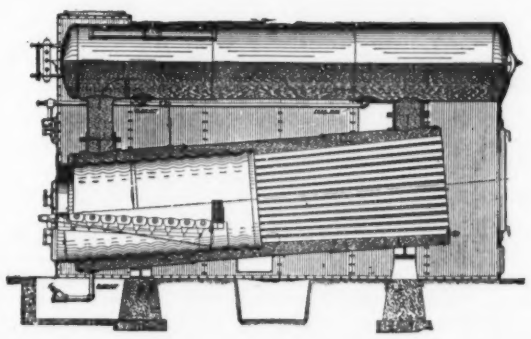
No Brickwork



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Adapted for installation with Babcock & Wilcox boilers without change in boiler setting.

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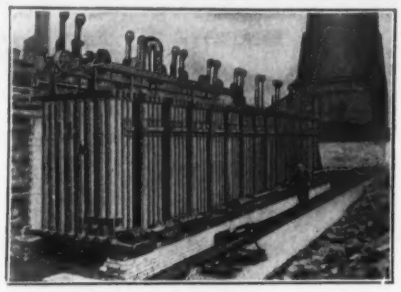

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A Green Economizer will recover heat from the hot gases from any kind of furnace or other source.

The Economizer heats water up to boiler temperature. It forms a large reservoir of hot water, which enables the boilers to better meet the sudden demands for steam frequently experienced in industrial plants.

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Sole Builders in this Country. 90

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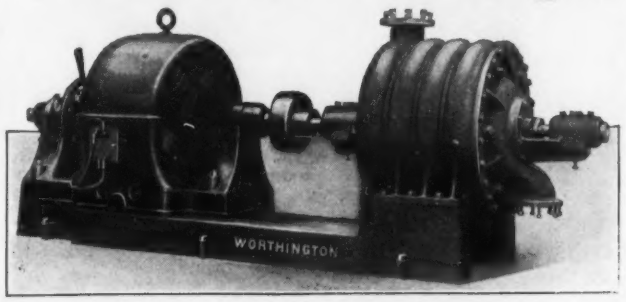

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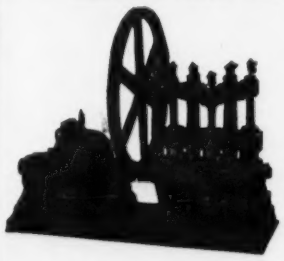
Made in a variety of types and sizes, adapted for Water Works, Hydraulic Elevators, Boiler Feeding, Apartment Houses, Mine Pumping, Irrigation, Paper Mills, Refineries, Breweries, etc. They can be operated by Electric Motor, Gas or Gasoline Engines, Water Power, Steam Engine, etc.



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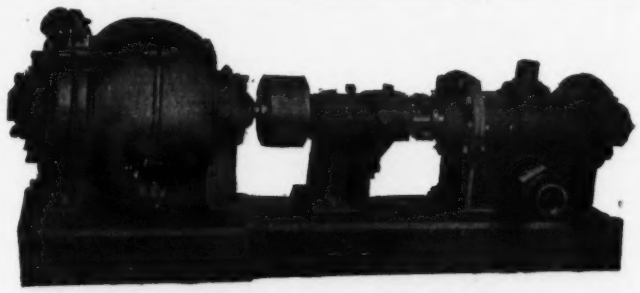

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Separates oil, water and steam from a mixture of the three and delivers them ready for future use. Heats feed water to 210° without causing back pressure. Removes back pressure where it now exists. Sent on approval to prove its worth.

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are universally used to clean and preserve boilers because they are scientifically made, put out in the most condensed form, and do the work most economically.

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One side can be cleaned while the other remains in service.

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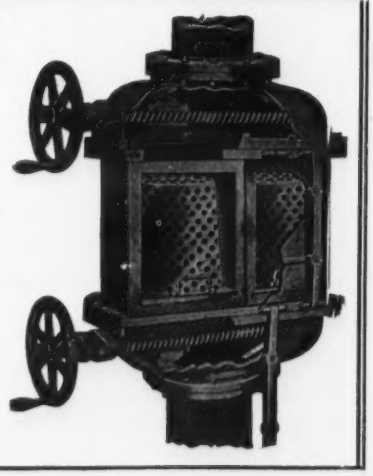
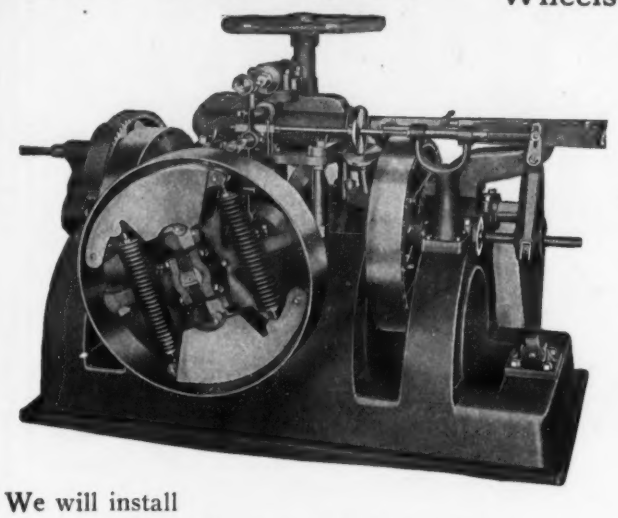


LIBERTY MFG. CO.
6901 Susquehanna Street
PITTSBURG, PA.

The Improved Governor for Water Wheels



We will install
The Improved Governor
in
COMPETITION
with any Governor on
A SIXTY DAYS' TRIAL
HOLYOKE MACHINE CO.
WORCESTER, MASS.

WATER WHEEL STATISTICS

The ***Pelton*** was the first impulse wheel—invented in 1888. Since then there have been manufactured ***12,500 Pelton Wheels*** with a combined capacity of approximately ***1,125,000 H. P.*** Single units ***1-8*** to ***10,500 H. P.*** Heads from ***20 ft.*** to ***2,200 ft.*** The ***Pelton Catalog,*** a treatise on ***Water Power,*** will interest the engineer.

THE PELTON WATER WHEEL CO.

19th and Harrison Streets SAN FRANCISCO
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AMERICAN STEEL FOUNDRIES

CHICAGO NEW YORK

DISTRIBUTOR FOR
NIAGARA FALLS TURBINES
STEEL CASTINGS
OF EVERY DESCRIPTION

DOBLE TANGENTIAL WATER WHEELS

Have been accepted as standard by reason of their high efficiency and remarkable durability. : : : :

AWARDED THE GRAND PRIZE AT THE ST. LOUIS WORLD'S FAIR

Hydro-electric Power Plant Construction a Specialty. : : *Write for our Bulletins.*

ABNER DOBLE COMPANY

ESTABLISHED 1850
ENGINEERS : San Francisco, U. S. A.
Exclusive Licensee in Canada
The John McDougall Caledonian Iron Works Co., Ltd., Montreal

New American Turbine Equipments

Designed and Built to meet any conditions.
SEE CATALOG 12.
THE DAYTON GLOBE IRON WORKS CO.
DAYTON, OHIO, U. S. A.

HOW DO YOU KNOW

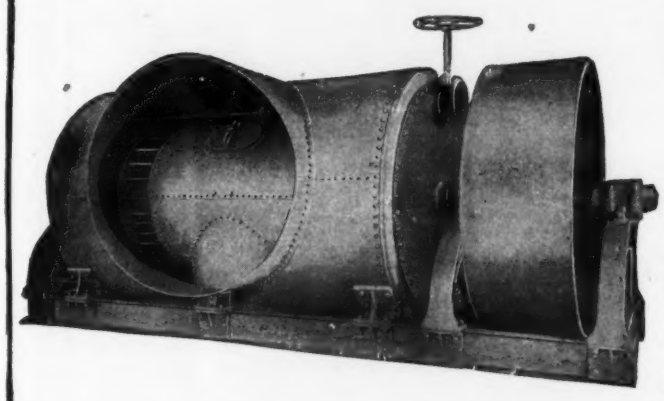
WE CANNOT PROVE TO YOU THAT OUR

GOVERNORS

ARE THE BEST

UNLESS YOU GIVE US A CHANCE TO DO IT? Write Us. Visit Our Plant

THE LOMBARD GOVERNOR CO. ASHLAND, MASS.



SAMSON TURBINE

If the SPEED of the turbine is to be controlled by a GOVERNOR, the turbine should be of such capacity that it will develop the MAXIMUM POWER required when operating at ¾ to ⅞-in. gate, then when an overload is thrown on, the governor can open the gates wider and allow an increase in power. The EFFICIENCY of the SAMSON between ¾ and ⅞ gate is over 84 per cent.

JAMES LEFFEL & CO.

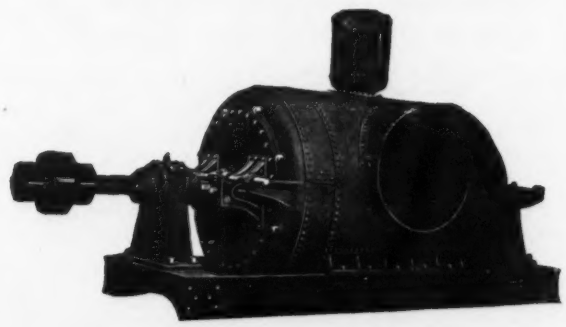
308 Lagonda St., Springfield, Ohio, U. S. A.

PAIR

McCORMICK TURBINES

"Pair McCormick Turbines, 1400 H. P., 400 R. P. M., 160 feet head, driving generator in power plant of the Cascade Water, Power and Light Company, British Columbia.

We design and build Turbines to meet requirements. Write for catalogue if interested."



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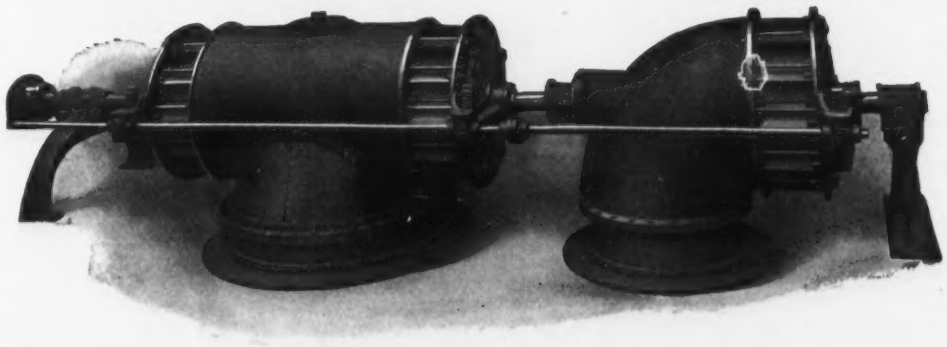

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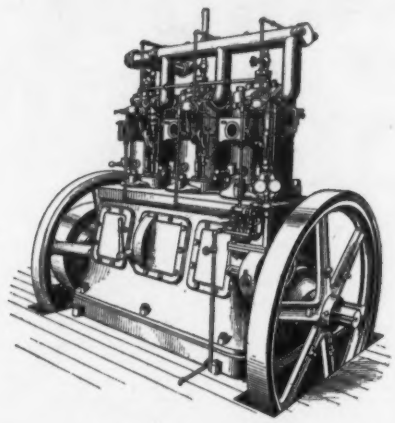
Hinged Gate Turbine

For speed, power and efficiency it equals any wheel made.

Upright and Horizontal.

These Turbines are recognized as the most effective water wheels made.

Your inquiries should come direct to us for this class of machinery.



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With fuel or crude oil at 3½ cents per gallon we will *guarantee*, under bond, that the cost of power with the Diesel Oil Engine in the purchaser's hands shall not exceed 33¼ cents per 100 brake horse power hours at half load and 28 cents per 100 B.H.P. hrs. at full load.

No steam engine, steam turbine, gas or other oil engine can approach even under test the absolute economy which we will guarantee.

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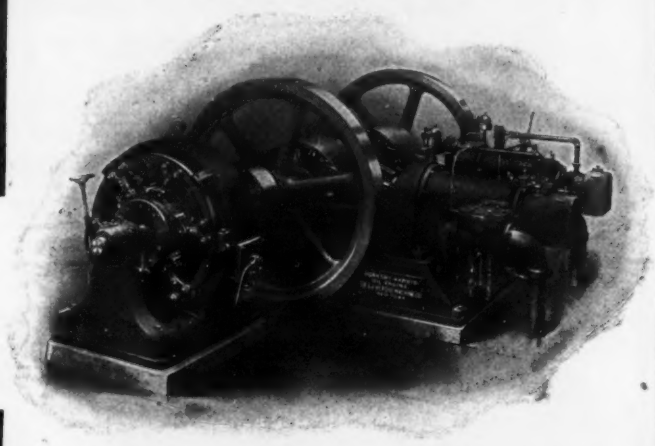
HORNSBY-AKROYD OIL ENGINES

14,000 IN OPERATION
5 TO 250 H. P.



A guaranteed fuel consumption of less than 1 pound of oil per brake horse-power hour. Kerosene, crude or fuel oil.

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NEW YORK FOOT E. 138th St,
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ONE HORSE-POWER ONE POUND OF COAL— ONE HOUR

This can only be attained by the use of a Gas Engine.

Gas Engines are now being built by several Companies in units of two thousand horse-power.

The very highest economy attainable exceeding any water power is by

Dr. Monds Producer Gas Process

whereby this pound is largely paid for from the by-products of the coal. *For full information, address*

R. D. WOOD & CO., 400 Chestnut St., PHILADELPHIA

We Guarantee Eighty Per Cent

of the full thermal value of Bituminous Coal, Lignite, Wood, and other fuels, converted into fixed gas, free from all impurities, by the

Loomis-Pettibone Gas Generating System

the volatile matter and tar being gasified by means of our patented processes, thereby greatly increasing the efficiency of the system and making it particularly adapted to the operating of gas engines.

Power and Mining Machinery Company
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(Suburb of Milwaukee)
ATLANTA BOSTON CHICAGO COLUMBUS DENVER
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WOODWARD WATER-WHEEL GOVERNORS

Are complete in themselves. No pumps or electric current required. The regulation is right and the price is right.

Ask for our catalogue.

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ROCKFORD, ILL.

The Buckeye Gas Engine

for every Electric Service, especially as a prime mover in generator units, for

Direct Connection to Generators

Perfect Running Balance and Speed Control

without counter balances and independent of sudden changes of load.

Self-cleaning from spent gases and dirt.
Duplicate ignition. Jump-spark if preferred.
85 per cent. efficiency demonstrated.

Write us if interested.

The Buckeye Engine Co., Salem, Ohio

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WHY Waste this valuable By-Product by Exhausting to the Atmosphere or Running your Engines Condensing?

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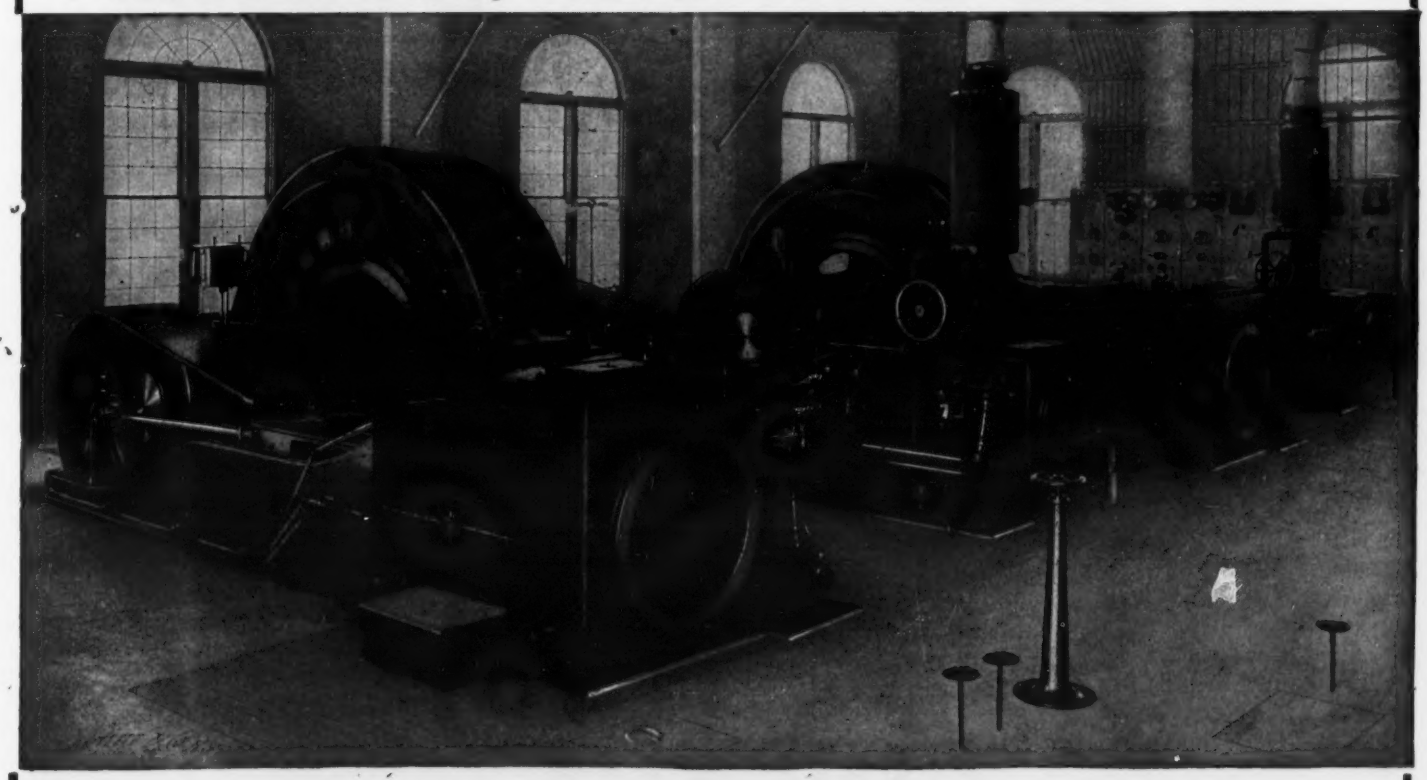

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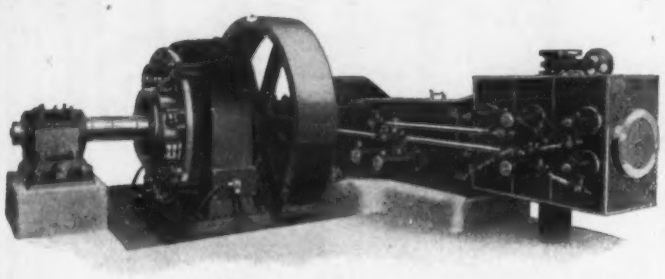

Corliss Engines

In our Corliss engines steam distribution is effected by four multiported valves of the Corliss type. The admission valves are operated by our patented positive motion valve gear which gives a movement practically identical with the Corliss releasing gear, i. e., holding the valves motionless during their unbalanced period. This permits of a higher rotative speed and better economy than the older forms of releasing gear Corliss engines. Send for our 25th Anniversary Booklet.

BALL ENGINE CO.

ERIE, PA.

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The only thoroughly reliable flange packing in the world.

Can't blow Rainbow out.

For steam, hot water, oil, ammonia, air or cold water joints.

Eighty-five per cent. of the power houses in the United States use the celebrated RAINBOW PACKING.

Isn't this a flattering testimonial?

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Peerless Rubber Manufacturing Co.

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MAY BE DEPENDED UPON
FOR EXACTING AND CONTINUOUS SERVICE

MACHINERY bearing our name may be depended upon in every respect. Only the very best MATERIALS, WORKMANSHIP and RESULTS are pledged. Hence FLEMING ENGINES should not be compared with those which are designed and built to render low prices the hoped-for attraction. Our Engineering Department is at your disposal.

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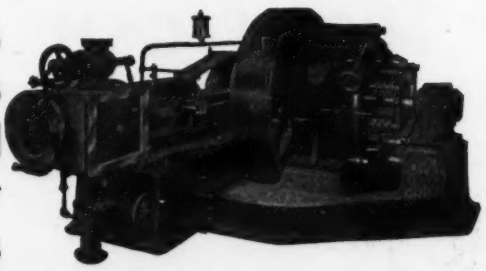
HARRISBURG, PA., U. S. A.
BRANCH OFFICES IN ALL PRINCIPAL CITIES.

Boilers Engines and Feed Water Heaters



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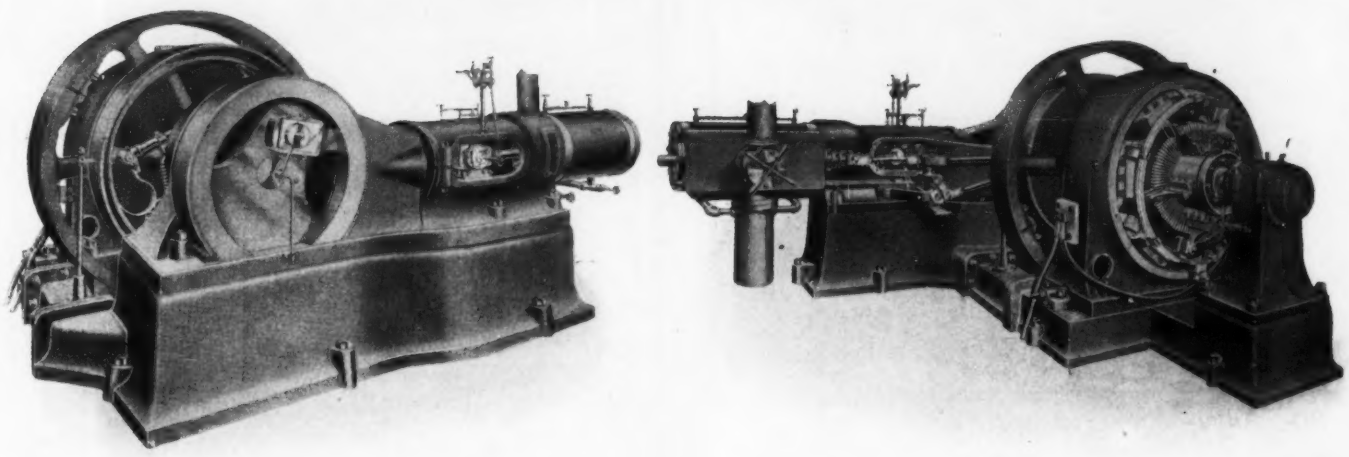
CORLISS ENGINES

BERRY SAFETY **BOILERS** POWER PLANTS

Buckeye Engine Types--3



ABOVE are shown front and back views of our Heavy Duty Class C Simple High Speed Buckeye Engine, direct connected to D. C. Generator. On account of its exceptional regulation and economy of operation, it has no superior for driving direct and alternating current generators where high speeds are desired, as in isolated plants or small stations.

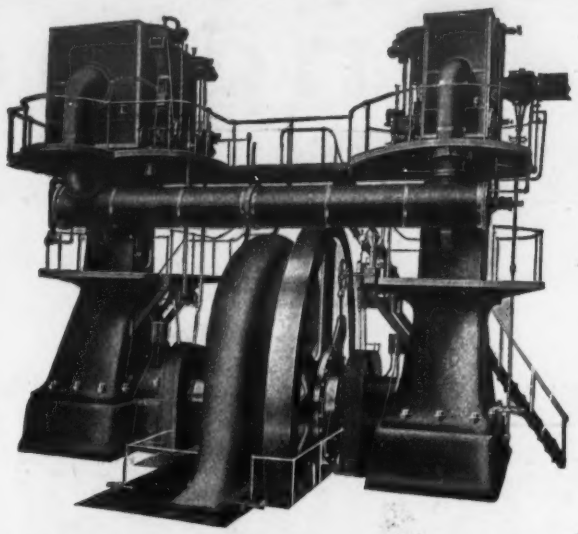
Notice the massive sub-base with extension to carry the generator—a perfectly self-contained unit.

All parts are accessible, while fully provided with oil guards.

This type built in sizes from 15 to 400 H.P. Other types and sizes to meet every requirement.

All described in detail in our catalog.

BUCKEYE ENGINE CO., Salem, Ohio



Vertical and Horizontal Engines
Slow and Medium Speed
Engines Steam Turbines

THE
Hooven, Owens, Rentschler Co.
Hamilton, Ohio

Northwestern Agency: R. B. Whitacre & Co.
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Those familiar with such things never dispute that fact. The use of Welded flanges has been limited only by the difficulty of obtaining them promptly and at the right prices.

Ballwood Welded Flanges

may now be had promptly in all sizes and according to specifications. They are made in the best possible manner, and are the only flanges in which both faces and periphery are machined true. Tell us your needs.

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Steam Engines, Rateau Turbines, Welded Flanges, Bends

Compound Steam Turbines
Direct Connected

Economical, Simple. Easily stripped and assembled. Compact. Fool proof. Self-balanced.
No counter-balancing pistons or labyrinths. No projecting buckets. No guide buckets. No valves. No expensive oil compression system. No gears.
Orders taken for units of from 600 to 10,000 horsepower.

AMERICAN TURBINE ENGINE CO.

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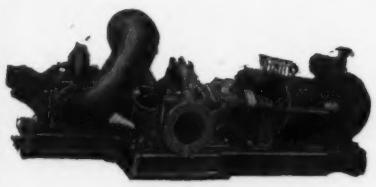
DE LAVAL



Steam Turbine Series Pump

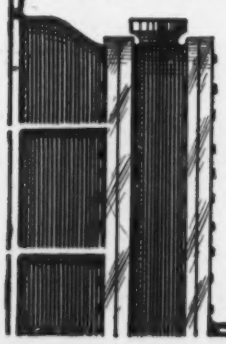
Steam Turbine Motors
Steam Turbine Dynamos
Steam Turbine Blowers
Steam Turbine Centrifugal Pumps
Electro-Motor Centrifugal Pumps

SEND FOR CATALOGUE NO. 24

DE LAVAL STEAM TURBINE CO.
Works and Sales Offices, Trenton, N. J.

The end of a condenser

shouldn't be even in sight after 10 years' service. Yet in several cases we know of, the condensing apparatus was completely worn out after 7 years' service and was then replaced by



Conover Condensers

which after 10 years' service are still good as new. They are the only condensers sold under a duty guarantee. May we send details?

WATSON MACHINE CO. Paterson, N.J.

Established 1829 — **I. P. MORRIS COMPANY** — Incorporated 1876
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Designers and Builders of Special Installations.

ENGINES High-Duty Pumping, Blowing and Mine Hoisting
Vertical and Horizontal TURBINES for High and Low Heads.
High-class, Fire Tube Types—Stationary and Marine **BOILERS**
Centrifugal Pumping Machinery, Tanks, Special Heavy Machinery, Parsons Manganese Bronze Castings a Specialty. Iron Castings up to 50 Tons.

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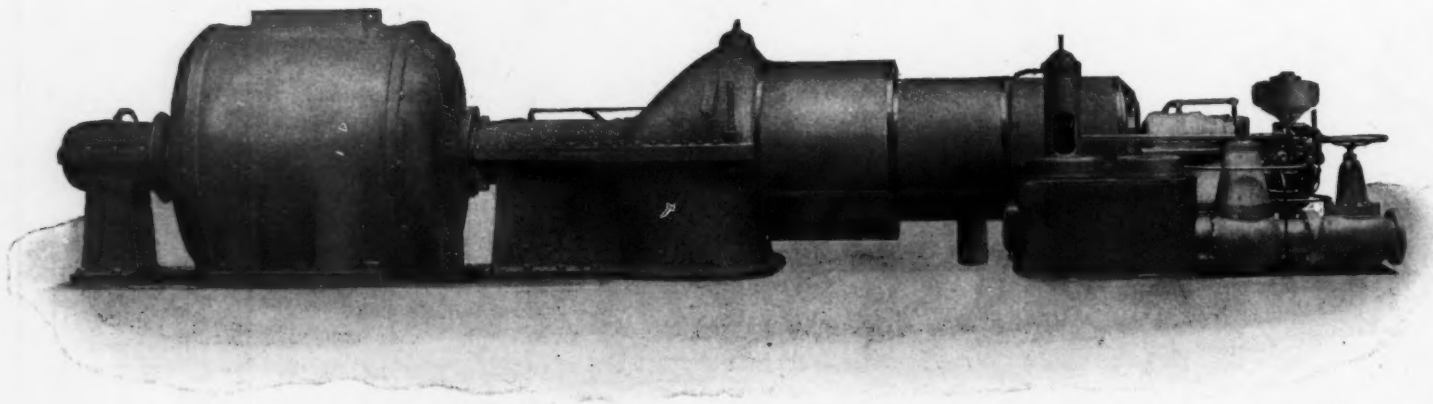
Providence, R. I.
Builders of Engines and General Machinery
Successors to
Providence Steam Engine Co., and Rice & Sargent Engine Co.
New York Office: 42 Broadway

ALLIS-CHALMERS CO
MILWAUKEE WIS U S A

ALLIS-CHALMERS STEAM TURBINES AND GENERATORS
ARE DEMONSTRATING IN DAILY SERVICE THAT THEY HAVE NO EQUAL
ON THIS CONTINENT



1500 K. W. Allis-Chalmers Steam Turbine and Generator.

AMONG OTHER PURCHASERS OF OUR STEAM TURBINES AND GENERATORS, ONE PROMINENT CONSULTING ENGINEER, alone, viz.: Mr. Thos. E. Murray, of New York City, HAS RECENTLY PLACED THE *NINTH* SUCCESSIVE ORDER FOR A COMPLETE UNIT. THE LIST OF INSTALLATIONS ALREADY MADE AND TO BE MADE FOR HIS CLIENTS IS AS FOLLOWS:

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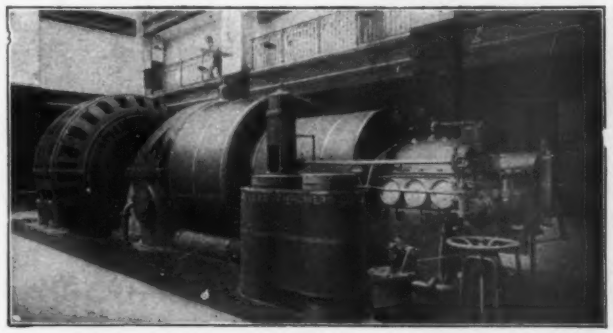
Kings County Electric Light and Power Co., Brooklyn, N. Y.	6000 K.W.	Utica Gas & Electric Co., Utica, N. Y.	1500 K.W.
New York Edison Co., Bronx Station	1500 K.W.	Westchester Lighting Co., New Rochelle, N. Y.	1500 K.W.
Helderberg Cement Co., Howe's Cave, N. Y.	1500 K.W.	Memphis Consolidated Lighting Co., Memphis, Tenn.	1500 K.W.
Dayton Lighting Co., Dayton, O.	1500 K.W.	TOTAL	26,000 K.W.

OTHER LARGE ORDERS, PLACED DIRECTLY WITH ALLIS-CHALMERS CO. BY THE OWNERS OF ELECTRIC RAILWAY, POWER AND LIGHTING STATIONS IN VARIOUS PARTS OF THE COUNTRY, ARE ALSO BEING RECEIVED IN SUFFICIENT VOLUME TO INDICATE A LARGE DEMAND FOR THIS IMPROVED TYPE OF TURBINE.

SPECIAL FEATURES OF OUR UNITS ARE:

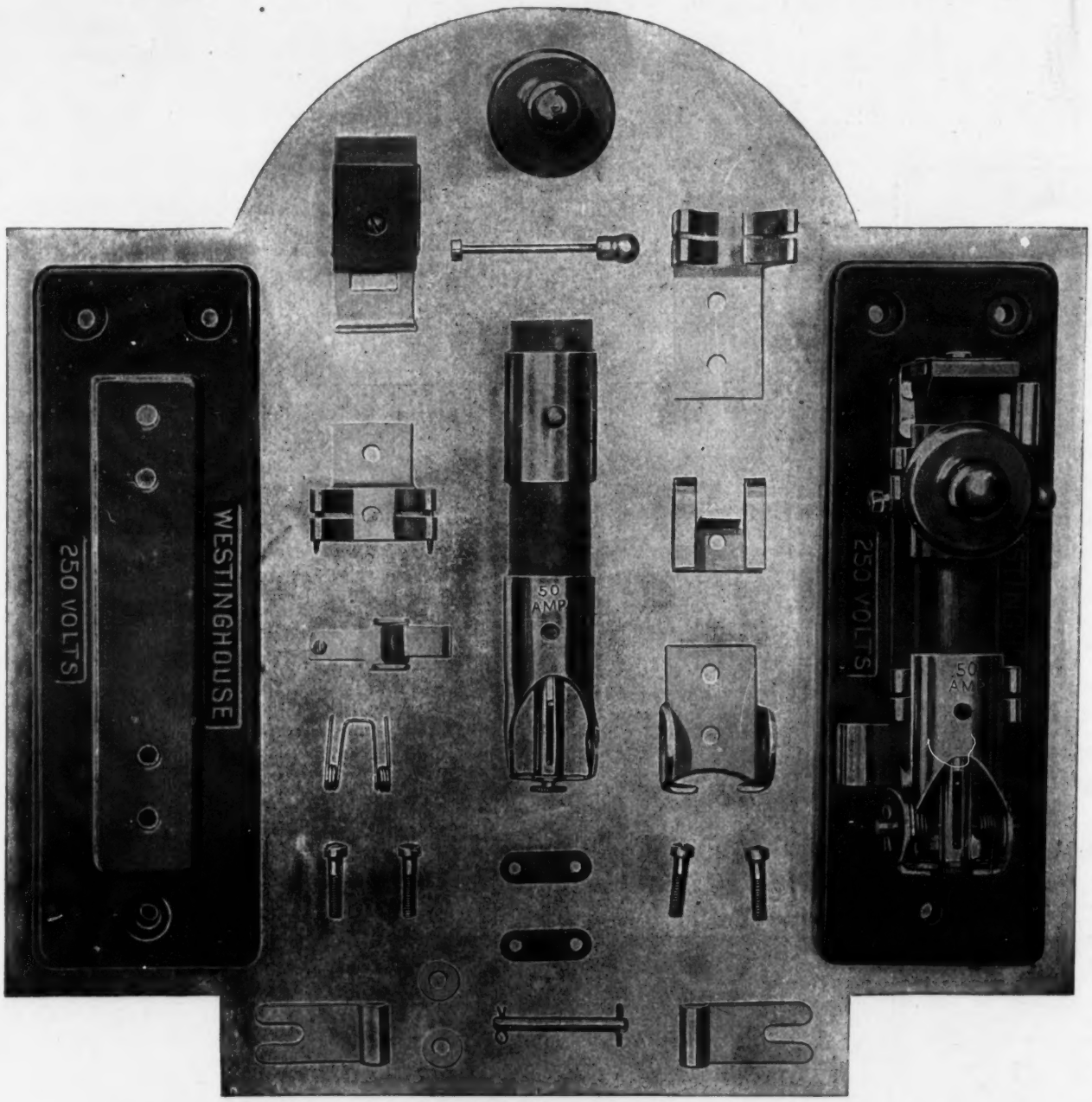
Channel-shaped shroud rings (patented, and controlled by us exclusively in America) riveted to the ends of the blades, giving great stiffness, permitting running with absolute minimum of clearance, and eliminating all danger of stripping. Accurate spacing and entirely secure fastening of the blading. Balance pistons of special design, small in diameter, which prevent distortion of the cylinders under varying temperatures. Revolving parts designed for high peripheral speeds. Ample provision made for ventilation. Perfect balance of the rotating parts, both of the turbine and the generator, resulting in a minimum of vibration, quiet operation of the generator and remarkable coolness of the bearings, which are continuously and automatically lubricated. High steam economy, even at rapidly fluctuating loads. Expansion complete. Adapted to high steam pressures and superheat. Water of condensation entirely free from oil. Large overload capacity. Small space required for installation as compared with the output. Simplicity of design throughout and ease of operation. No appreciable deterioration under long and severe service.



Allis-Chalmers Steam Turbine and Generator Installed.

Westinghouse

Type F Circuit Breaker



We illustrate complete, and in detail, a carbon-break circuit breaker which, within its range, is equal to any other breaker of five times its cost.

Westinghouse Electric & Mfg. Co.

Address Nearest District Office. PITTSBURG, PA.

Atlanta	Buffalo	Cleveland	Detroit	New Orleans	Pittsburg	San Francisco
Boston	Chicago	Dallas	Los Angeles	New York	St. Louis	Seattle
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Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ontario. Mexico: G. & O. Braniff & Co., City of Mexico.

Westinghouse

Portable Lamp Testing Volt-Wattmeter

Every Central Station Should Have One

Can be used without change of calibration on either alternating or direct current circuits. Reverse readings not necessary on direct currents. A socket is provided for the lamps to be tested.

There are two concentric scales, one indicating watts, the other volts. The wattage of the lamp or the voltage of the current can be read by using the switch to cut the series windings in or out.

Westinghouse Electric & Mfg. Co.

Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Los Angeles, Minneapolis, New Orleans, New York, Philadelphia, Pittsburg, St. Louis, Salt Lake City, San Francisco, Seattle, Syracuse

Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ontario.

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The Roney Stoker

19,000 H.P. of Roney Stokers on second floor of boiler room, 74th St. Power Station, Interborough Rapid Transit Co., New York.

Simplicity of Operation

is a marked characteristic; two simple adjustments, both within the comprehension of the ordinary fireman, control the whole action of the stoker, forcing, checking or banking the fire at will.

Write for our Roney Stoker Catalogue

The Westinghouse Machine Co.

DESIGNERS AND BUILDERS OF Steam Engines, Steam Turbines, Gas Engines, and the Roney Stoker

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THE SUPERIOR CONDUIT FOR INTERIOR WIRING

NATIONAL METAL MOLDING CO.,

FULTON BLDG. PITTSBURG, PA.

Bishop Gutta Percha Co.

Makes a specialty of Flexible Wires and Cables for Elevator Control, Electric Lights in Elevators and Theatre Cables, all Flame Proof and of best material.

If you want the best rubber insulation for any purpose, ask for

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Bare & Insulated Electric Wire
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1870 - EUGENE F. PHILLIPS - AMERICAN ELECTRICAL WORKS - 1882

Do you buy belting by the pound weight or by the pound pull?

If the first, you probably get ordinary, oak-tanned belting, because it's cheaper per lb. Oak-tanned belting is stiff, hard and short fibered. It must be put under heavy tension to prevent slipping, wasting power in the shaft bearings and requiring a bigger belt.

SHULTZ SABLE BELTING

is rawhide inside, kid surface outside. It is strong and tough like catgut, but more flexible. It clings to the surface of the pulley and can be run slack. (Did you know that the pull of belts on pulleys may vary from 15% to 55% of the pressure? Sable is in the 40-and-up class.) Send for *Sable Book* No. 10 and we'll tell you a few things about belting.

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Philadelphia, 116 N. Third St.

The Coal & Iron National Bank

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National Electrical Code Standard

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

"O. K." Weatherproof
Slow-Burning Weatherproof
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